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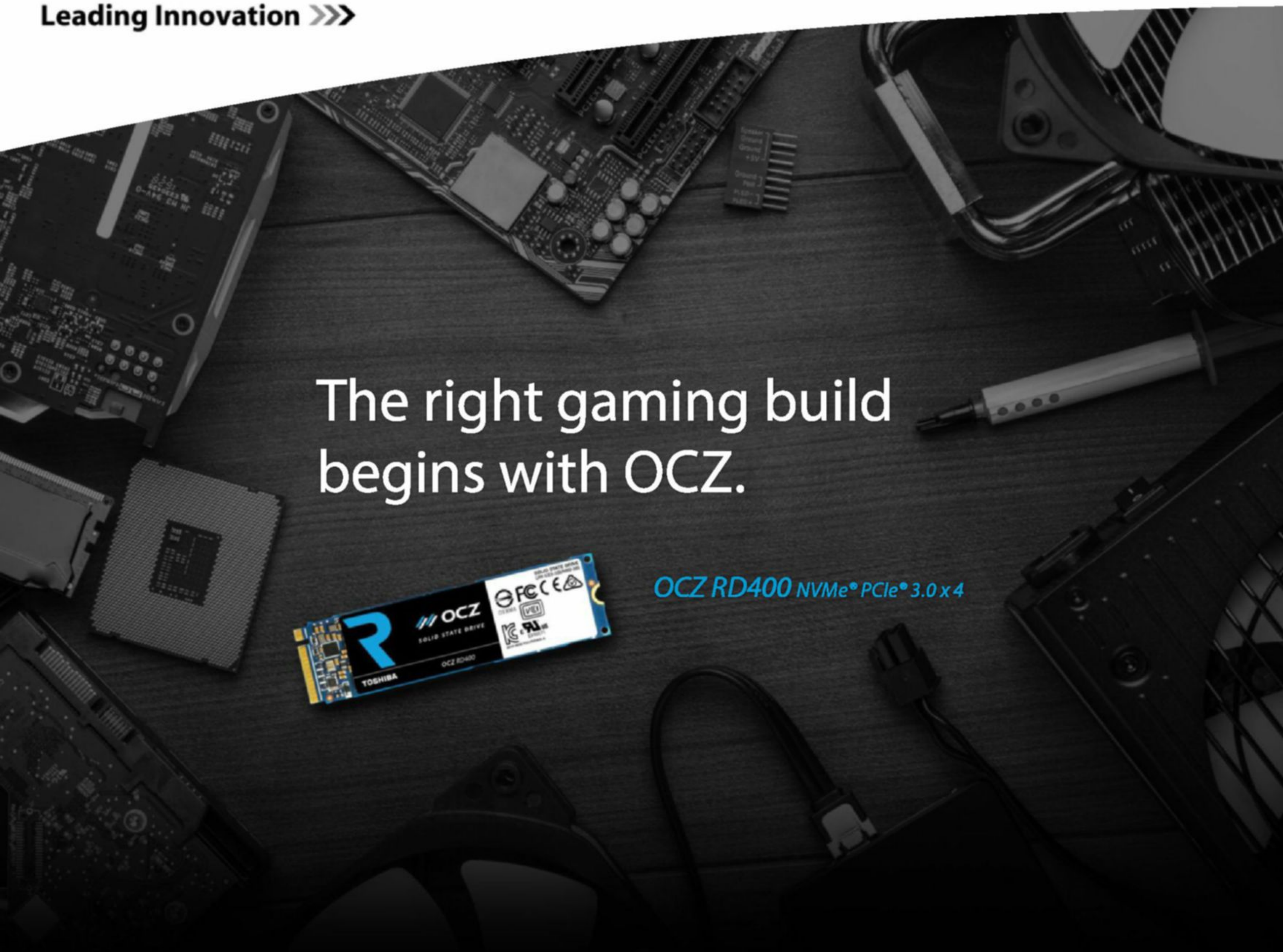

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Tuan
Nguyen

THE NEW DREAM MACHINE

DREAM MACHINE is back, and this year it's literally gargantuan outside, as it is on the inside. Never before has Dream Machine been this big at the micro level. Of course, I'm talking about cores—10 of them, in fact. Powered by Intel's behemoth Core i9-7900X, Dream Machine 2017 is mammoth by pretty much all measurements. And so is everything else about this tower of ludicrous power.

The premise behind Dream Machine is a simple one: Put together the purest, most audacious computer we can, with no limits in mind. This means all components are up for consideration, regardless of their price. Think a high-end system costs $5,000? Think again. $10,000? Weak.

Every issue we put out is a celebration of the PC in every aspect. From the hardware to the software, the platform is a Mecca if you want value and performance. You can have things your way, to your own specs, and on your own terms. So our terms were to gather the best and most hard-edged gear we could find, and put together a system that would be formidable in gaming, productivity, and daily general use.

But it wasn't easy. Last year's Dream Machine was already a hard beast to tame, and by any standard still rocks even high-end systems today. Besting last year's machine came down to delicate choices: CPU, GPU, and storage. The first two are always difficult because AMD, Intel, and Nvidia tend to start talking about new products at around the same time our Dream Machine issue goes to print.

I always advise people to just get on with it, though. If you keep waiting for the next great component, it'll never come. As soon as you're ready to make a purchase on the part you've been waiting for, news will come out about the next-generation product. It'll be a vicious cycle—the endless waiting game. Rather than waiting around, we decided that Dream Machine would be built on products you can buy today.

While I realize that *Maximum PC's* Dream Machine is obscene, it doesn't diminish your dream machine or anyone else's. Everyone has different specs in mind for what they want their individual PC to be, and what makes this possible is the very essence of the builds we put together. It comes down to the total experience, and the joy of putting together a kick-ass rig for your own needs is irreplaceable.

Back in 2015, I built Dream Machine for the magazine, then that system sat on an empty desk for a really long time, and went to waste. Frustrating, I know. Zak, Alan—if that happens again this year, I'll gladly take it off your hands!

Tuan

Tuan Nguyen is Maximum PC*'s editor-in-chief, also known as "the pointy end of the stick." He's been writing, marketing, and raising hell in the tech industry for 20 years.*

↘ submit your questions to: comments@maximumpc.com

THE NEWS

Where Are All Our Graphics Cards?

Cryptocurrency mining rush causes worldwide shortage

HAVE YOU tried buying a high-end graphics card recently? Almost everything above budget is in short supply. Manufacturing hasn't been interrupted, but there has been a massive spike in sales, and the culprits are cryptocurrency miners. It is economically viable to use consumer hardware to mine coins again, and speculators have snapped up stocks of the best cards to do it.

Mining cryptocurrencies involves a huge amount of convoluted math, and GPUs are well suited to the task, the Radeon Polaris GPU in particular. Supplies of these were soon exhausted, so the miners turned to Nvidia Pascal-based cards—not as effective, but efficient enough. Some high-end Pascal cards aren't compatible with the mining software and are still to be had, but otherwise you're out of luck. Meanwhile, there's been a boom in the secondary market for old Radeon cards.

Bitcoins are now relatively mature—their value recently hit $3,000 a pop, and mining them is well out of the reach of consumer hardware, even dedicated ASIC hardware struggles to do it economically. However, Litecoin and Ethereum mining is resistant to dedicated hardware, and it's largely these that have powered the boom, notably in China and Japan.

Ethereum went live in 2015, and rapidly became the second largest cryptocurrency. Tokens, called Ethers, jumped from $20 in March this year to $400 in early June, before calming down to $200 by July. Litecoin has seen its value triple in under two months. These lucrative returns have fueled the feeding frenzy.

It's good news for graphic card makers, of course. Asus, Sapphire, and MSI have all built dedicated mining cards to exploit the fresh market, mostly based around the Radeon RX 470. These cards often only sport a single video output, or even ditch them altogether. There are dedicated mining motherboards as well, notably the BTC-branded boards from ASRock. Its latest offering, the H110 Pro BTC+, can take 13 graphics cards at once.

> Litecoin and Ethereum mining is resistant to dedicated hardware.

The Asus Mining P106 is built specifically to mine cryptocurrency.

Thinking of building a mining rig? Think again. Cryptocurrencies are very volatile. Fluctuations in price can quickly leave your mining machine consuming more in electricity than it returns in coins. There are speculation bubbles that can cause prices to halve or double in a day.

The increasing difficulty of mining also acts as a natural brake—it soon reaches a point where only serious players need apply. Getting in early makes all the difference. By the time these booms hit the mainstream, the wheels have generally fallen off the bandwagon. Pundits are already declaring that small-scale Ethereum mining is "dead."

If all this sounds a little crazy, you may be right. The idea of making money using math is weird from the start. However, as the major financial institutions become more accepting of this new money, we will see much more of it. It has been estimated that worldwide Ethereum mining consumes 4.69 terawatt hours of electricity—enough to run a small European country.

We've been here before, of course. At the end of 2013, there was a similar shortage of GPUs as Bitcoin mining took off. High-end Radeon cards will be back in good supply soon, and the market will settle down to normal. We can probably expect another spike in demand at some point, though, as another digital currency captures the interest of the miners. But it would be good if these didn't interfere with the supply of our gaming cards.... **–CL**

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DIGITAL DETECTIVES

Your technology may betray you

A CONNECTICUT MAN'S claim that his wife was murdered by an intruder has been challenged by detectives due to his wife's Fitbit. It recorded her moving about the house an hour after her supposed death. An Arkansas man's murder of a friend was caught out by his Amazon Echo, which captured accidental recordings, and by his water meter, which recorded his attempts to wash away blood in the early hours. And an Ohio man's attempted insurance fraud was uncovered by data on his pacemaker, which showed he wasn't asleep when he claimed his house "accidentally" caught fire.

All recent examples of how technology can catch us out. As the IoT expands, we are being monitored and recorded on an unprecedented scale, our cells, watches, and cars all track and record. A new breed of detective is being born, one who sifts through our digital footprint for clues. Often, it's not that difficult either—a surprising number of people research their intended crimes on Google, for instance, or use their satnav to make journeys they later deny.

In our everyday lives, we leave a considerable digital trail. And who owns that, and how much privacy over it we have, has yet to be clarified. Initially, Amazon refused to hand over data to investigators in the Arkansas case, claiming it was protected under the First Amendment. The suspect volunteered the data, presumably thinking it wouldn't be incriminating, which avoided a stand-off. The law has a lot of catching up to do. Until then, companies such as Apple and Amazon will set their own policies on what they will hand over and to whom.

The power and convenience of technology is marvelous, but as a price for that we often give away details of our private lives that we might hesitate to tell our neighbors. The surveillance is not being foisted upon us, we willingly buy it. How much of this collected data can be used against us is a debate to come. Meanwhile, detectives will be doing a lot more detecting from the desktop. **–CL**

WIN 10 CREATORS FALL UPDATE

EMPHASIS ON CROSS-PLATFORM CONNECTIVITY

MICROSOFT'S SECOND WIN 10 UPDATE of the year promises to "further power your creativity." Whatever. But it does have some nice features, many aimed at cross-platform synchronization. Microsoft has finally accepted that we have Android and Apple phones.

A new cloud-based clipboard makes shifting things between devices easier. Pick Up Where You Left Off makes sharing files across devices much easier, too, while Timeline enables you to go back to what you were doing, showing the apps and files you were using.

OneDrive Files On-Demand is better at using cloud files, as you can see them in Explorer, but nothing is downloaded until you need it. And Story Remix—a fancy slideshow that includes mixed reality—could be fun. Under all this will be a raft of tweaks and changes, plus an updated GUI called Fluent Design. Of more immediate interest is AI-powered malware protection, which promised intelligent threat detection and protection. **–CL**

Qualcomm 835
snapdragon

APPLE AND QUALCOMM FIGHT GETS SERIOUS

Lawsuits start to pile up

THE SPAT between Apple and Qualcomm just gets worse and worse. Both parties have reached for the legal sticks to beat each other. Apple claims that Qualcomm was using illegal business models in demanding royalty payments and a percentage of iPhone revenue in return for use of its patented technology. It's suing for $1 billion in the US. It claims that some patents are invalid, and that Qualcomm has failed to charge fair and reasonable rates.

Qualcomm alleges that Apple has infringed its patents, and is seeking a ban on certain iPhone models being imported in the country. It claims that Apple has deliberately checked the performance of its chips so as not to outshine Intel's chips. None of this is very edifying. Lawyers will earn some hefty fees, while we may lose gigabit LTE speeds. Currently, only Qualcomm's chips can handle these, ready for the iPhone8—Intel has chips in the pipeline, but they won't be ready in time. **–CL**

Tech Triumphs and Tragedies

A monthly snapshot of what's good and bad in tech

TRIUMPHS

IBM MODEL F RETURNS
The lovely buckling spring mechanical keyboard of the '80s is to be built again. Yours from $325.

NEW TWITTER ART STAR
A stag beetle called Spike has created doodles with colored markers that now sell for $300 or more.

GOOGLE TO STOP READING YOUR EMAILS
Your Gmails will no longer be used to target you with adverts, although Google still scans them.

TRAGEDIES

ICEWIND DALE II GOES MISSING
Beamdog's update of the classic game has been foiled; nobody can find the source code.

HARASSMENT NOW AN ONLINE FEATURE
A new report claims that one in five of us will experience severe harassment online. Ouch.

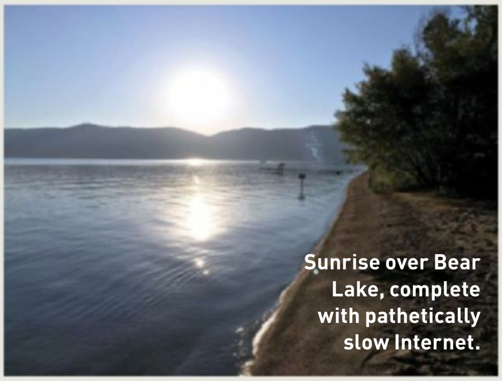
WINDOWS MOBILE IS DEAD
Not officially, but development team lets slip that we shouldn't expect to see any new features.

Jarred Walton

TECH TALK

Going Off the Grid

LET'S NOT MINCE WORDS: I've been around the block, technologically speaking. My first "real" computer was a Commodore 128 in the mid-80s, and I cut my teeth on MS-DOS 2.x on an IBM PC XT compatible. Our family got a special with the C-128, where it came with a free modem, capable of an astounding 300 baud. I hardly remember how we found out the numbers for various bulletin board systems (BBS), but there were hushed whispers of phone numbers in the school hallways, or at the weekly Dungeons & Dragons sessions.



Sunrise over Bear Lake, complete with pathetically slow Internet.

I remember the squeal of the modem as it connected, followed by ASCII art welcome screens. One popular BBS in my youth had an ASCII art picture that was about three screens' worth of text. Let me help our younger readers put that into context. The C-64 (because almost no software ran in the native C-128 mode) used a television for its display, running a 40x25 character text interface. 300 baud meant I could transfer a bit less than one line of text per second, so just waiting for the welcome screen could take a couple of minutes. But then, loading games off floppies—and, before that, tape drives—took several minutes as well, so we learned patience.

After a few years, we upgraded to a 9,600 baud modem. My BBS world was radically altered when I discovered welcome screens popped up in a matter of seconds! No longer did I need to think about whether it was worth the delay to go view a new screen; I could check it out, and if it didn't catch my interest, I could exit and find something else to do. Modems picked up speed, and I eventually moved to a 28.8k and then 56k model, but somewhere along the way, the Internet happened. Even a 56k connection could feel slow when surfing the web, especially for sites that included a lot of images.

When I upgraded to broadband DSL in 1996, capable of a whopping 768kb/s, I couldn't believe how fast everything felt. Even complex web pages opened in seconds, and "massive" 50–100MB downloads only required 10–20 minutes. (Remember, Windows 95 was only a couple hundred MB.) My patience muscles were still in great shape coming from dial-up, so I didn't mind the wait. Twenty years later, though, I am no longer a patient man.

My home Internet connection is pretty fast, at 250Mb/s down but only 12Mb/s up, and multi-gigabyte downloads are commonplace. I have a dozen or so web pages open at once, 20 or more devices are connected to my network, and life is good. But every so often, you need to get away from it all and go on vacation. Which is where I am now.

The world has been radically altered by high-speed Internet connectivity and mobile broadband. I'm in the sticks, tethered to my smartphone, and I can pull data at about 1.5Mb/s. I'd have been more than happy with such a connection in the late 90s, but in 2017? Yuck! I'm ready to scream, waiting for just my standard web pages to refresh. Just the PCGamer.com/hardware page takes about 10 seconds to load, which isn't too bad, but multiply that by 15, and it feels like going from an SSD back to floppy disks.

It makes me wonder: With 100Mb/s and faster Internet connections now quite common, and the bleeding edge fiber connections pulling 1–10Gb/s, in another 20 years will I find 250Mb/s unacceptably slow? Will we all have 40–80Gb/s connections, available wherever we go, streaming augmented reality to our glasses, and enabling experiences we can't begin to imagine? I hope so! But we might run into the same limitations we're hitting with processors, where the rate of advancement no longer comes in quantum leaps, but in incremental steps.

Whatever happens, I'll still need to drop off the grid on occasion, and leave my cell phone in the tent. Always on, always connected? Nice in theory, but sometimes I don't want to be found. Now, pardon me, I have some swimming to do....

Jarred Walton has been a PC and gaming enthusiast for over 30 years.

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Alex Campbell

OPEN SOURCE

Debian 9 Is a Great OS, but Not for a Performance PC

YOU WANT STABILITY if you're flying commercial or passenger jets, but if you want fighter-like high performance, it can hold you back. It's the same for software: Debian 9 is that passenger plane.

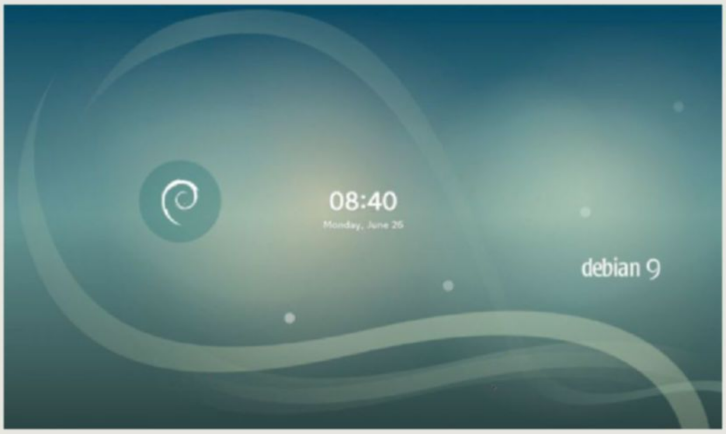
As I was taking a look at the new release of Debian 9 "Stretch" soon after its release, I began thinking of something beyond the OS I was testing. Sure, Debian's structure is the technical basis for Ubuntu, but Debian represents much more. It represents stability and reliability in the Linux space. And being a vanguard of stability is great for commercial and industrial Linux, but is it great for desktop users?

In the years I've been using them, Linux OSes have been innovating and getting better every day. While Linux can do lots of things that Windows and Mac can't, it's also perpetually trying to catch up with things such as drivers and software availability. For the desktop user, that means if you want to get the most out of your GPU or shiny new CPU, you have to get the latest kernel and drivers pronto.

The thing is, those new drivers may be full of bugs. And some of those bugs make your system unstable. Few things induce more headaches than updating a graphics driver only to find on the next reboot that the X server won't start. Or that a kernel driver won't load. Or (in the case of self-compiled Nvidia drivers) that your driver isn't compiled against the new kernel you just updated to.

These annoyances have driven me to yell, curse, and lose sleep as I try to figure out what's gone wrong and how to fix it. Nevertheless, I still run Arch Linux on my personal machines to get the latest features as they appear. Every time I perform a full upgrade of the software on my system, I have to take it on faith that my PC will still work as intended.

That's not what operating systems like Debian and Red Hat Enterprise Linux do. These OSes are geared for stability. Their repos generally don't contain software that will break your system, and rigorous testing ensures that a system will keep running without issue. That's important, because outside of the desktop, Linux is the dominant OS on this planet. Your smart thermostat, most internet servers, and driverless cars all use Linux. In each of these cases, stability and security are paramount. After all, if a driverless car segfaults while moving at 60mph, it can kill people. In comparison, having to recompile a video driver on a PC isn't such a big deal.



Debian 9 has a number of desktop environment options, including GNOME, KDE, Cinnamon, and MATE.

If you're looking to try Linux for the first time, I still recommend OSes like Fedora or Ubuntu. Why? Because they strike a good balance between stability and agility. Debian can feel a bit draconian after Ubuntu, as you may end up using older software than you would find in a comparative Ubuntu release. Ubuntu 17.04 shipped with kernel 4.10, while Debian 9—released two months later—shipped with kernel 4.9, for example.

If you've built a PC with performance in mind, chances are that you're not exactly playing it safe when it comes to stability. (Overclockers, I'm looking at you.) For folks who like to push the envelope, running a more stable distribution could serve as a hindrance. In those cases, learning on Fedora or Ubuntu, and then going to something more bleeding-edge, such as Arch, Gentoo, or openSUSE Tumbleweed, will offer the latest software soonest. After all, if you're trying to get the most out of your PC, there's a good chance you're willing to put in the time and effort if something goes wrong.

Alex Campbell is a Linux geek who enjoys learning about computer security.

THE LIST

THE BEST GAMES FROM E3 2017

AGE OF EMPIRES: DEFINITIVE EDITION This remastering of the original supports 4K, and more.

LONE ECHO VR in general may be uninspiring, but the multiplayer part of this could be a turning point.

XCOM 2: WAR OF THE CHOSEN An expansion that looks to make a tough experience even harder.

EVIL WITHIN 2 Fans of survival horror are in for a treat with this gruesome-looking sequel.

DESTINY 2 The first game never made it to PC, but there's lots of excitement about this second appearance.

A WAY OUT This adventure looks awesome, and demands you play it as co-op, for an interesting twist.

ANTHEM The new IP from the original developers of *Mass Effect* looks gorgeous and moves well.

WOLFENSTEIN: THE NEW COLOSSUS This sequel to the *Wolfenstein* reboot looks great fun.

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HEAD TO

BY EXECUTIVE EDITOR **ALAN DEXTER**

Mini-ITX vs. ATX

One of the attractions of PCs is that they come in all shapes and sizes, and you can build whatever system you want. Some love a full ATX system, while others only ever consider a compact Mini-ITX build. While there have been plenty of form factors over the years, there are four common ones these days: ATX, Mini-ITX, microATX, and Extended ATX (something of a niche). Of these, the battle generally comes down to a choice between ATX and Mini-ITX, but what are their benefits? Which should you use for your next build? Allow us to help.

ROUND 1

Performance

The general perception for a long time was that if you wanted serious performance, you needed a full-sized motherboard and a sizeable full-tower case to put it in. Because, you know, size matters. An obvious win for the bigger formats, then? Not quite. The thing is, the world has changed, and as more and more silicon is squeezed into the CPU packaging itself, you're losing out less when it comes to dropping down from an ATX to a Mini-ITX or microATX form factor. In fact, when it comes to the core functionality, about the only thing you can lose is support for SLI, because Mini-ITX only boasts a single PCIe slot.

That consideration aside, most Mini-ITX motherboards boast feature sets that are comparable to their ATX siblings, and when it comes to raw performance, there's pretty much nothing you can do in a larger case that you can't do in a well-designed compact chassis. Planning on water-cooling your CPU? Plenty of the cases we look at in these pages support 240mm radiators, and we always consider them in that light, so you'll be able to overclock your CPUs just as much as you can in a larger case.

Tie:
Mini-ITX, ATX,
microATX, Extended ATX

ROUND 2

Expansion

What do you really need in your PC? Once you've got your CPU, motherboard, memory, graphics card, PSU, and storage in place; what other components do you actually need to make it do what you want? The days of needing soundcards, network interface cards, SCSI boards, and various other goodies are long behind us (thankfully). And while there may be specific instances when you need to reach for such hardware, your motherboard does it all.

The reason we're talking about expansion is because it's the main differentiator between the form factors. ATX can, in theory, squeeze up to seven expansion slots into its 12 x 9.6-inch space (realistically, E-ATX is a better option if you need all seven), while the 6.7 x 6.7-inch Mini-ITX boasts a single slot; microATX offers a maximum of four, with SLI/CrossFire a possibility.

Storage is another consideration: Mini-ITX boards tend to have fewer SATA ports, often as few as four, while ATX can easily hit 10. Obviously, smaller cases don't have room for so many drives, either. So, ultimately, we have to give this one to the bigger form factor, although whether you actually need so much room is another matter.

Winner:
ATX

ROUND 3

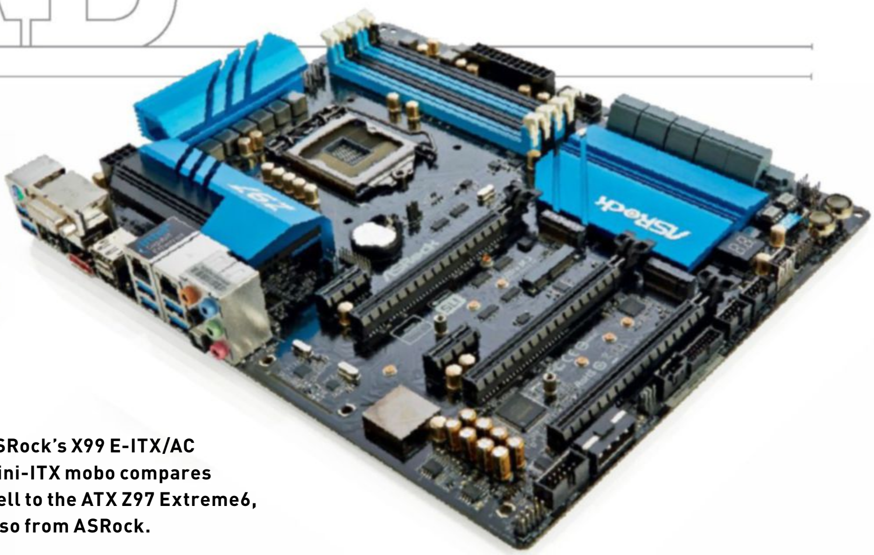
Compactness

Your choice of motherboard doesn't necessarily have to dictate your chassis. If you want to slot a microATX motherboard into a full ATX case, you can. It's the same story for Mini-ITX mobos as well, because the four mounting screws are compatible with all modern cases (older cases may not be compatible, though, so that's worth bearing in mind). Obviously, you can't ease an ATX motherboard into a case designed for Mini-ITX, unless it happens to be a Tardis, but generally you have plenty of options for how you marry up case and motherboard.

The point is: You can still build a huge-ass system even if you decide to go down the Mini-ITX route, but with the advantage that you can actually build a much smaller machine, should that be a requirement. And space can often be a defining factor for new builds, particularly if you want the final machine to sit on the top of your desk, rather than be hidden underneath it. A compact build, with a dash of water cooling, can make for a beautiful thing—an important factor for more and more of us nowadays. Which means that if space is a factor, then it's hard to go too wrong with Mini-ITX.

Winner:
Mini-ITX

HEAD



ASRock's X99 E-ITX/AC Mini-ITX mobo compares well to the ATX Z97 Extreme6, also from ASRock.

ROUND 4

Ease of Build

While we're big fans of compact Mini-ITX builds, there's no getting away from the fact that they don't always play nice. Confined spaces can lead to scrapes and cuts, but it's actually the frustration that comes from working in such a tight space that really grinds our gears. You can do it, and the resultant machines can make the effort pay off, but be prepared to spend much, much longer getting everything just right than with an ATX system. A tip on this front would be to connect and build as much as possible outside of the case before sliding your motherboard into place.

Conversely, building inside a large chassis is a pretty straightforward endeavor, with plenty of room for routing cables, space to easily reach components, and sufficient airflow without having to make sure every cable is tied down. You'll find you have more options when it comes to placing your components as well, whereas in a smaller chassis you tend to find that there's only one place that your hard drive can go, or your all-in-one radiator can be placed. Adding more components to a bigger chassis is also much easier. So, it's a relatively easy win for the bigger form factor in this round.

Winner:
ATX

ROUND 5

Availability

Not only do you have the most options when looking at ATX motherboards, but new platforms are developed with ATX in mind. It's where most of the market is, so it makes sense to ensure that's working first. Other options, such as microATX and Mini-ITX, come later. That's been fine for years, as motherboard manufacturers have had plenty of lead time to get these niche platforms sorted, meaning there hasn't been much delay in getting your hands on a tiny motherboard. However, since Ryzen launched, there have been scant Mini-ITX motherboards for us to get hold of, and the options for the new X299 platform aren't much better—we're aware of a single X299 Mini-ITX board, the X299E-ITX/AC, which has to work some pretty impressive technical wonders in order to squeeze such a massive socket on to such a small board (like using SO-DIMMs).

The same is true for cases—smaller form factor chassis occupy a niche in the market. Which all adds up to a reduced selection for anything smaller than an ATX motherboard in a tower case. It's generally worth shopping around to get the platform and form factor you want, but your options will be more limited.

Winner:
ATX

And the Winner Is...

We build plenty of machines here on *Maximum PC:* at least one an issue, and usually several more. The majority of these machines are ATX rigs, although over the past year we've dabbled with Mini-ITX a few times, while the Dream Machine tends to go on the bigger side of things. In other words, we have plenty of experience of building across various platforms and form factors.

Do we have a preference? We do have a fondness for smaller systems, as they look awesome when built properly, although we make no bones about the fact that they're not always the easiest systems to put together. Throw in some water cooling, and you end up with a machine that looks amazing on your desk, as opposed to something you want to hide under it.

These thoughts are reflected in this head to head: ATX is easier to build with, more readily available, and offers more options for expansions and upgrades. Mini-ITX and microATX produce more compact systems, that perform just as well as their bigger cousins, and generally don't limit what you can do. It's good to have options. ⏻

DOCTOR

THIS MONTH THE DOCTOR TACKLES...

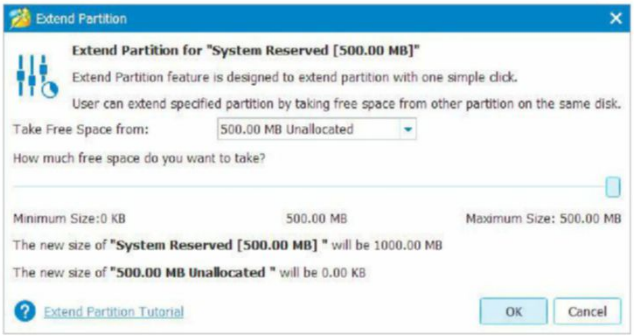
> Processor Pairs
> 4K Foray
> Ryzen Hopes

Doubling Up

Hi Doc, I recently found out that you can have two CPUs instead of one. However, I don't really understand why you'd need a pair of processors. Is it for Bitcoin mining? Gaming? Can you please explain what a dual-CPU configuration would be good for? **–Nikita Plutenko**

THE DOCTOR RESPONDS: Today's desktop CPUs include anything from two to 10 cores. Technologies such as Hyper-Threading double the number of processes that each of those cores can schedule, allowing a lot of computation to happen in parallel. Adding cores/threads helps maintain a smooth experience when you have many programs running concurrently—otherwise known as multitasking. Or, it improves performance in individual applications optimized to exploit host processing resources.

Now, let's say part of your job involves transcoding video, consolidating servers via virtualization, or running scientific computing workloads requiring tons of RAM. Each of those tasks is notorious for taxing high-end hardware. A mainstream Core i7 or Ryzen-based platform might limit their performance, costing time and money. Stepping up to a multi-socket motherboard makes it possible to drop in a second (or more) CPU, multiplying core count, I/O, and memory support, ideally alleviating your bottleneck. Although these sophisticated systems command a significant up-front investment, they often pay for themselves by accelerating workloads that generate revenue.



Extend Partition for "System Reserved [500.00 MB]"

Extend Partition feature is designed to extend partition with one simple click.

User can extend specified partition by taking free space from other partition on the same disk.

Take Free Space from: 500.00 MB Unallocated

How much free space do you want to take?

Minimum Size:0 KB 500.00 MB Maximum Size: 500.00 MB

The new size of **"System Reserved [500.00 MB] "** will be 1000.00 MB

The new size of **"500.00 MB Unallocated "** will be 0.00 KB

MiniTool Partition Wizard Free's Extend Partition tool moves unallocated space automatically.

While it's certainly possible to mine Bitcoins (or Litecoins, or Ethereum) using a CPU, that's not very efficient. Bitcoin mining is dominated by purpose-built ASICs, while other popular altcoins are mined more effectively using highly parallel GPUs, rather than CPUs. So, it doesn't really make sense to spend big on a dual-processor workstation for cryptocurrency work.

Similarly, games benefit most from a fast graphics card. Many titles are written to utilize four or more CPU cores, but don't scale much further. You have little reason to buy an eight or 10-core processor explicitly for gaming, much less a PC with two of them.

Partition Control

Dear Doc, In the June issue, you talked Joel Vignere through expanding his reserved partition. But you neglected to mention that the new unallocated space behind the C: partition needs to be moved and located behind the reserved partition. The reserved partition won't expand until this is done. Although this seems petty, a novice reader might get frustrated and use nasty adjectives to describe the Doc's advice.

–Max Canestraro

THE DOCTOR RESPONDS: Thank you for the follow-up, Max. As a refresher, the Doc suggested that Joel use MiniTool Partition Wizard Free to first shrink his OS partition, and then extend his system reserved partition, creating enough room for Windows to finish updating.

If Joel followed the Doc's advice and ran the tool's Move/Resize Partition function, he saw three text boxes under Size and Location: "Unallocated Space Before," "Partition Size," and "Unallocated Space After." Dragging the partition's handle in on the left made the "Unallocated Space Before" field grow, circumventing the issue you describe. Dragging it from the right created more "Unallocated Space After" (after the C: partition, that is). Either way, you end up with a chunk of storage space labeled "Unallocated."

He was then able to run Extend Partition to grow his system reserved partition. Directing that feature to take free space from the unallocated

↘ submit your questions to: doctor@maximumpc.com capacity does perform the move operation you mention, if necessary, so there should be no need for nasty adjectives.

4K for Non-Gamers

Hi Doc, I'd like some advice on buying a graphics card for a 4K monitor. I consider myself a technologist, a gadgeteer, an overall computer enthusiast, and a long-time reader of *Maximum PC*. But not a gamer.

There are plenty of articles about graphics cards and 4K monitors, but they're all gaming-focused. What about those who don't play games? While I'm not necessarily on a budget, I don't want to overspend just because I'm unsure which card has enough power for the tasks I do run. Besides standard productivity apps, I'll be editing photos, doing some light 4K video editing, and watching movies.

If you're wondering why I'm interested in 4K, there are a few reasons. To be honest, the high resolution just seems fun and cool, and I'd like to be able to enjoy the technology (I mentioned I'm an enthusiast, right?). Second, I need more screen space than 1080p affords. I've read reviews that say a 4K monitor is better than two lower-resolution ones, but I'd be interested to hear your first-hand experience. Third, high DPI has me salivating.

Oh, and are there any features like G-Sync that I can forgo to save some extra money? **–Joey Lazzara**

THE DOCTOR RESPONDS: Games aren't the only applications that benefit from a fast graphics card. Adobe Premiere Pro CC (2017), for example, accelerates certain effects through CUDA (in the case of Nvidia GPUs) and OpenCL (for AMD and Intel engines). Similarly, Photoshop includes a number of features that are offloaded to the GPU through OpenGL or OpenCL. So, you'll have to decide how important performance is in non-gaming workloads that still utilize GPU resources.

As for watching movies, even low-end cards include fixed-function hardware dedicated to handling media playback. But do note that if you're looking to go bleeding-edge with Ultra HD Blu-ray, DRM will likely dictate your build's composition: Windows 10, a seventh-gen Core CPU, HD Graphics 630 or better, a motherboard with Intel Software Guard Extensions support, an HDCP 2.2-compatible display, and an Ultra HD Blu-ray playback-capable optical drive are all required, in addition to playback software such as CyberLink's PowerDVD 17.

With those requirements in mind, the ultimate approach to saving money would be to buy a Core i5 or Core i7 CPU with HD Graphics 630 built-in, snag a compatible motherboard, such as Gigabyte's Z270X-Gaming 9, and connect an HDCP 2.2-equipped 4K monitor.

As for the Doc, he prefers the compartmentalization possible on three QHD displays for productivity tasks over one 4K screen.

GPU Upgrade Time

Hey, Doc. After occasionally buying *Maximum PC* at the store, I decided to subscribe recently. I have a question about upgrading my PC: Right now, I own an old Dell OptiPlex 780, and was told that the best graphics card I can get for it is a low-profile GeForce GT 1030. I want to know your opinion of that board. Can it hit 60fps? Is it worth buying? **–Tyrone**

THE DOCTOR RESPONDS: There are several versions of the OptiPlex 780. You were probably told that a low-profile GeForce GT 1030 is the best card you can get due to its size, meaning you own the desktop or small form factor configuration, with limited room for an upgrade.

Depending on the games you play, it is possible to average 60fps or more with Nvidia's entry-level Pascal-based board. Dial the details down in *WoW*, and you'll see more than 100fps at 1920x1080. Mainstream titles such as *Dota 2* and *StarCraft II* leave plenty of room for fluid frame rates on GT 1030 at FHD, too. Newer games may require stepping down to 1280x720 for playable performance.

All of that assumes a fairly modern test platform, though. Your Dell OptiPlex 780 sports a Core 2 Quad CPU, at best, and may only have 2GB or 4GB of DDR3 memory. Rather than spending $70 to get a little more life out of that old desktop, consider saving up for a better-balanced setup. Complementing a new graphics card with a current-gen CPU and solid-state storage will grant you a much more enjoyable experience.

Firmware improvements from partners like MSI make AMD's Ryzen platform compelling.

Is Ryzen Viable?

Hi Doc, A couple of years ago, I decided to move away from Win XP and adopted Win 7; I like it a lot. I did try Win 10 during the preview, but I'm 81, and it's just not for me. I don't play games, but I do work with videos, and also enjoy fast response times.

Now I'm finding that my current rig won't work with the latest M.2-based NVMe SSDs. I originally planned to buy a new PCIe adapter. However, while it may work with my existing setup, I suspect it won't improve performance due to a motherboard-imposed bottleneck.

After reading *Maximum PC's* take on the new AMD Ryzen CPU, I'm thinking of buying one, or waiting until the release of Threadripper. I'd like your opinion on whether it's worth holding off for, or if I should buy one of the existing Ryzen chips. Right now, I'm looking at the MSI X370 Gaming Pro motherboard and a new DDR4 memory kit. I assume all of that would work with either Ryzen 5 or 7, right?

If I wait, how much more would I be spending compared to Threadripper's potential performance increase? With Intel already starting a price war with its new Core i7/i9 models, it looks like Black Friday is coming early.

Oh, one more thing: My GPU has DDR3 memory. Will it still work on the new machine? My current rig consists of an FX-8350 on Asus's M5A99FX Pro R2.0, 16GB of DDR3-1866, two 240GB Intel SSD 530 drives, two 1TB Caviar Black HDDs, and a Radeon R7 240, all under Windows 7 64-bit.

–Howard VanDover

THE DOCTOR RESPONDS: At the time of writing, not enough is known about AMD's forthcoming Threadripper for the Doc to guide your path confidently, Mr VanDover. The 16-core/32-thread CPU will require a new motherboard, and it'll no doubt be quite a bit more expensive than any existing Ryzen 5 or 7 processor. Plus, you'll need a quad-channel DDR4 memory kit to fully exploit its architecture.

Regardless of the chip's final specs, your utilization of such a complex piece of hardware will depend wholly on the tasks you perform and whether they're bottlenecked by, say, an eight-core Ryzen 7, or its 16 lanes of PCIe 3.0 connectivity.

The Doc can tell you that Ryzen 5 and 7 look a lot better now than they did at launch. Constant firmware updates and software optimizations smoothed out many of the platform's initial quirks. Oh, and AMD does support Windows 7 through its chipset drivers. A Ryzen-based PC will yield a significant speed-up compared to your current FX-8350 setup.

As for your graphics card, yes, AMD's Radeon R7 240 will work on an X370-based motherboard. Just don't expect much contribution from it if you're using GPU acceleration in your video editing projects.

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DREAM MACHINE 2017

IN THE MIDST OF CHAOS, there is also opportunity. In the convoluted world of transistors and nanometers, battles are being fought, as Intel and AMD vie for your hard-earned cash. The core count is rising, and we're currently seeing the landscape change at an incomprehensible rate. Soon, 16- and 18-core parts will become the weapons of choice for anyone looking to build such a ludicrously bank-breaking system as this.

For now, though, the heady heights of 32 threads are nothing more than a fevered dream, hidden from consumers until their grand masters see fit to release them upon the computational world. But Dream Machine doth wait for no man. It's the culmination of a year's worth of technological development, and the machine we build now, one of the most powerful and intricate of its kind, would look very different if we were to build it in even six months' time. It is an exercise in hubris, neither adhering to any budget, nor any perceived spec—it is the best of the best of what we have available today.

Dream Machine is a concept, not something that should ever really be attempted. It is, by its very nature, an unreasonable machine, beyond any recommendations. So, when no holds are barred, what can you do with the latest and greatest hardware out there? That's what we're here to find out—to build, in-house, one incredible system, at one incredible price. **–MAXIMUM PC STAFF**

AS WE'VE ALLUDED TO ALREADY, speccing out Dream Machine 2017 was a challenge. The processing world is in a state of extreme flux right now, with both Intel and AMD providing fantastic solutions for anyone looking to build beyond a quad-core system. And let's go on the record: If AMD's Threadripper were available today, with all of its 16 cores, we would have used that (believe us—we almost had it, but, unfortunately, AMD wouldn't budge its shipping deadline by a week), and if Intel's $2,000-plus Core i9-7980XE were around, that would have been on the cards, too. However, deadlines are a kicker, and you could wait around forever for the next big thing.

INGREDIENTS

PART		PRICE
CPU	**Intel Core i9-7900X**	**$1,000**
Motherboard	**Gigabyte X299 Aorus Gaming 9**	**$500**
RAM	**128GB** (8x 16GB) **Crucial Ballistix Elite**	**$1,408**
GPUs	**2x Nvidia Titan Xp**	**$2,400**
OS Storage	**2x Samsung 960 Pro 512GB M.2 PCIe SSD RAID 0**	**$600**
AD Storage 1	**Samsung 960 Pro 2TB M.2 PCIe SSD**	**$1,313**
AD Storage 2	**2x Samsung 850 Pro 2TB**	**$2,000**
HDD	**2x HGST Ultrastar He10 10TB 7,200rpm**	**$1,000**
PSU	**Corsair HX1200i and CableMod Cable Kit**	**$621**
Case	**Phanteks Enthoo Elite Super Tower Case** (Black)	**$900**
Cooling	**EKWB Cooling Suite, 8x Corsair ML120 Pro, 3x Corsair ML140 Pro**	**$2,405**
Monitor	**Asus PG27UQ 27-inch 4K 144Hz HDR**	**$2,500**
Mouse	**Mionix Castor**	**$53**
Keyboard	**Logitech G413 Carbon**	**$90**
Headphones	**Beyerdynamic DT 1770 Pro**	**$600**
Microphone	**Razer Seiren Pro**	**$250**
Accessories	**Rode PSA1 Boom Arm, Noblechairs EPIC Series** (White), **Nvidia HB SLI Bridge**	**$480**
OS	**Windows 10 Home OEM**	**$100**
Total		**$18,220**

1

CPU CONUNDRUMS

We went through three iterations of tubing runs before settling on two bow loops. The distance between the memory fitting on the left of the CPU and the one on the right is about half an inch, so we couldn't use one as a template, and instead had to bend both loops by hand, using two different cylindrical objects—in this case, our deburrer and an unused reservoir.

2

CUSTOM CABLES

These cables turned out great, and definitely add some pizzazz. Our one regret? Not opting for longer cables. The Elite is ridiculously big; the 24-pin was fine, but the two eight-pins at the top nearly didn't make it. If it weren't for some clever routing and Phanteks's eight-pin EPS extensions, we wouldn't have made deadline.

3

PASS-THROUGH PERFECTION

One of the main reasons we wanted to use the Enthoo Elite was the compartmentalized design. Combining it with pass-through fittings keeps the top aesthetic exceptionally clean, and allows us to hide the majority of our more complex tubing runs out of sight between the two loops, and behind the back of the case.

4

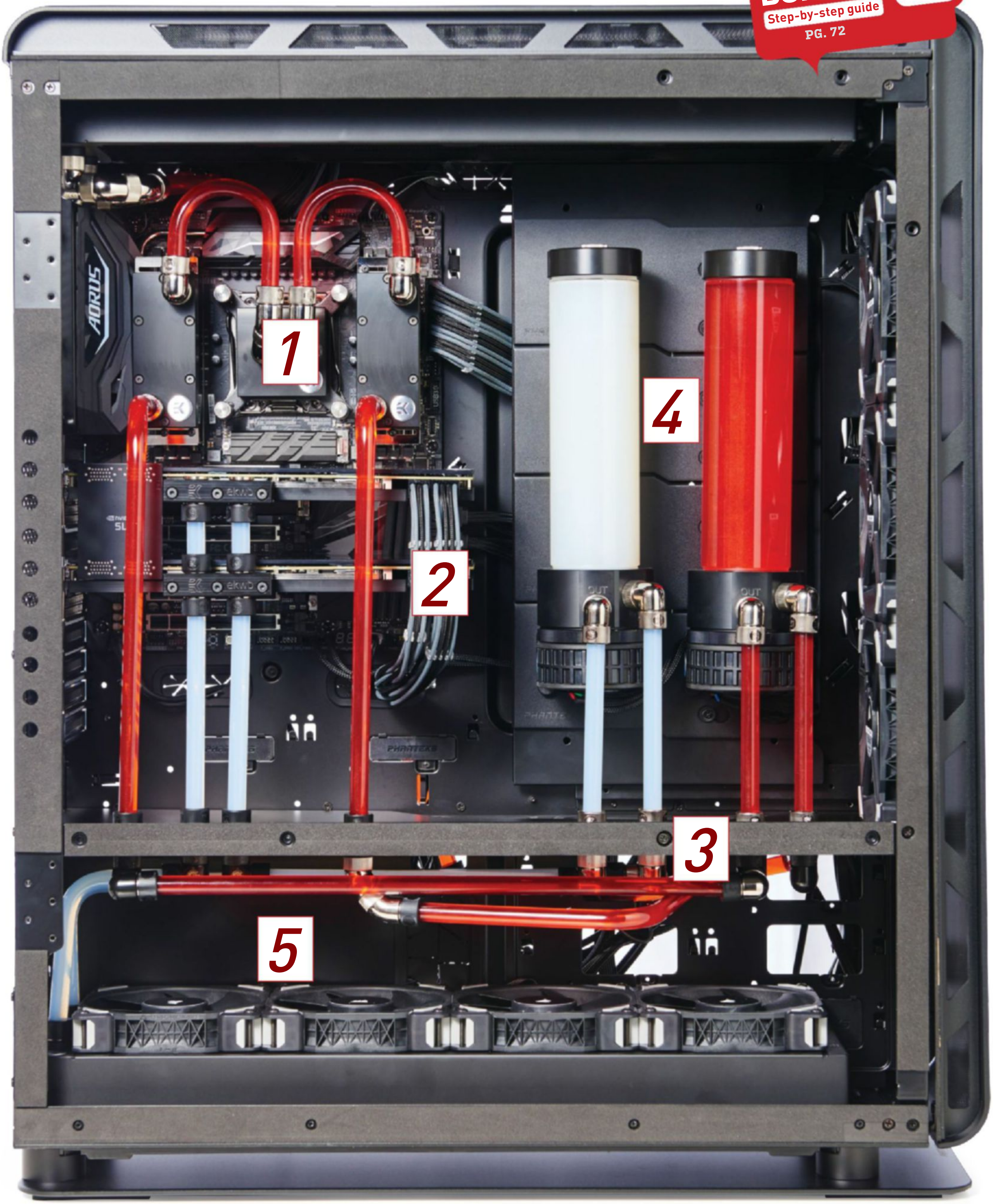
RESERVOIR RIDICULOUSNESS

These plates are genius. Designed to hide SSD/HDD mounting points, you can remove or keep them, depending on what you plan to install. If you want to install a res, remove one of the brackets, and choose whichever fittings you want. We drilled straight through the aluminum plate to install our two reservoirs, to keep the aesthetic clean and fit more than one loop.

5

HARD DRIVE HIGH JINKS

"But *Maximum PC*? Where are the two 10TB hard drives?" Good question. We actually took them out of this shot, so you could see the complexity of the tubing runs, leading into the back of the chassis. However, the hard drives fit here snugly, under the tubes and slightly above the fans/radiator, on included brackets. You can just about spot the mounting hooks.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- NVIDIA® GeForce™ GTX 1070 8GB GPU
- 16GB Dual Channel DDR4-2400MHz Memory
- 250GB WD Blue M.2 SSD + 1TB 7200RPM Hard Drive
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- Headphone output w/ESS SABRE HIFI Audio DAC

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PROCESSOR

INTEL CORE I9-7900X

The name of the game this time is 10 cores and 20 threads. Intel's latest Skylake X parts are some of the gnarliest we've seen. With a reimagined smart-cache superstructure and a top-end turbo of 4.3GHz, the Core i9-7900X is a single-core IPC-demolishing and multi-core rendering powerhouse.

This is also Intel's first use of its Turbo 3.0 tech. Similar to AMD's XFR smart overclocking, in applications that aggressively use fewer than four threads, the Core i9-7900X allocates the process to its "best" cores, and boosts their clock speeds up to 4.5GHz. Anything capable of maxing out more than four brings the entire chip back to the 4.3GHz standard Max Turbo.

Compared to last year, we've also seen improvements to the number of PCIe lanes (from 40 to 44), an increase in DDR4 memory support, and the DMI (direct media interface between the processor and chipset) improve from 4x PCIe 2.0 lanes to 4x PCIe 3.0, to alleviate any bottlenecks.

The Core i9's true potential, however, lies in its overclocking capability. It's an intriguingly mixed bag. And, for once, we're not limited by silicon instability, but by thermals. There's no denying the i9-7900X is one hell of a hot chip. Even with a 240mm AIO cooling the 10-cored behemoth, overclocking even to 4.5GHz can lead to thermal throttling hitting that TJMax of 100 C. That said, if you can circumvent the cooling conundrums with a sound liquid-cooled setup, it's not impossible to see 4.8GHz or 4.9GHz—potentially even 5.0GHz—on this powerhouse of a chip, pushing Cinebench R15 scores all the way up to 2,600-plus, and smashing CPU-heavy rendering times into the dirt.

MOTHERBOARD

GIGABYTE X299 AORUS GAMING 9

When it came to choosing a motherboard, we had a few criteria in mind. We needed a board that could overclock like a champ, with a clean-looking black aesthetic, and have the potential to support up to three PCIe M.2 drives, without any ugly protrusions jutting out from the PCB.

The last part was our main concern. We wanted two 512GB Samsung 960 Pros in RAID 0 for our OS, and a 2TB model for anything else we could think of. Coupled with two old-school 10TB HDDs, plus two 2TB Samsung 850 Pros for even more storage, and connectivity is hugely important.

That left us with one winner: the Gigabyte Aorus X299 Gaming 9, a mammoth of a board to fit inside our equally gargantuan case. It's one of the only mobos to support more than two PCIe SSDs on the board itself, second only to the Gaming 7, which lacks the heatsinks. Plus, its onboard audio is exceptional, it features dual eight-pin EPS power for smoother voltage application during overclocks, and five PCIe x16 lanes, in theory enabling us to run three-way SLI in x8x16x8 configuration.

GRAPHICS CARD
DUAL NVIDIA TITAN XP

12 Tflops of pure force, 3,840 CUDA cores, 12GB of GDDR5X, and the full might of Pascal's GP102 core. Multiply that by two, and what you're left with is $2,400-worth of pure graphical power.

Pascal was nothing short of a master stroke by Nvidia, making the impressive Maxwell architecture look like a toddler's plaything in comparison. Designed to put AMD's Vega on the back foot, we doubt even Nvidia expected what was about to occur. As AMD vacated the upper echelons of performance GPU computing, Nvidia was left unchallenged. Fast-forward a year and the Titan X (Pascal) of that generation was trumped by Nvidia's own GTX 1080 Ti, matching it spec for spec, sans one extra GB of GDDR5X. The solution to derailing its own flagship? Unleashing the full might of the GP102 core on to the world.

Featuring an additional 256 CUDA cores, 16 more texture units, and an impressive boost to core and memory clocks, the true Titan Xp arrived to sink its teeth into that upper ecosphere once again. A true 4K gaming card—but at a cost.

GEFORCE GTX
GEFORCE GTX
TITAN X

BUILD IT!
Step-by-step guide
PG. 72

MONITOR
ASUS PG27UQ

The PG27UQ here is one of only two prototypes in existence. We called in some major favors with Asus to get this for Dream Machine 2017—and, boy, is it impressive! Although likely not available until the end of the year, Asus has told us it should cost around $2,500. Yeah, that's ominous.

It's hard to deny how incredible it is. Asus has always been at the bleeding edge of monitor development, and this is no exception. The PG27UQ is a 27-inch 4K IPS (in-plane switching) panel, capable of a 144Hz refresh rate, a 4ms G2G pixel response time, with HDR, quantum dot, and G-Sync tech included as well.

We've seen screens push beyond the bandwidth limits of 60fps 4K, but most operate with multiple DisplayPort cables, and often not that well. With the PG27UQ, Asus has taken advantage of the new DisplayPort 1.4 standard included in RX 400 series and GTX 10 series cards and above. Although overall bandwidth hasn't increased since DP 1.3, it does feature Display Stream Compression 1.2, allowing visually lossless encoding with a compression ratio of 3:1 versus DisplayPort 1.3's 2:1. This means DisplayPort 1.4 can support 8K at 60Hz, and more importantly for us, 4K at 144Hz, with HDR enabled.

RAM

128GB *(8X 16GB)* CRUCIAL BALLISTIX ELITE DDR4-3200

Memory hasn't changed a huge deal since our last venture into the heady heights of Dream Machine stardom—maximum capacity remains the same at 128GB, and the only thing that really has seen any increase is frequency, which now caps out at around 4,266MT/s. That said, at that speed, you cut your maximum capacity in half, and as massive advocates of capacity over speed, we simply can't warrant it over the alternative.

That said, we did want to do something different, so this time around we decided to put all eight DIMMs on ice, stripping them of their stock heatsinks, and liquid-cooling the lot of them. We've always loved Crucial's memory kits for their stability, availability, and performance, so we requested in a not-so-subtle 128GB (8x 16GB) of its Ballistix Elites, running at 3,200MT/s, with a CAS latency of 16. It does feel something of a shame to strip these kits down, because the powder-coated finish on the heatsinks is one of the nicest we've seen, but the aesthetic finish and extra pep that liquid cooling your memory adds to a water-cooled loop is hard to deny, especially when you're chilling two banks of the volatile SOBs.

SSD

SAMSUNG 960 PROS *(2X 512GB & 1X 2TB)*, SAMSUNG 850 PRO *(2X 2TB)*

For our OS storage, we knew we wanted something a little faster than your standard M.2 PCIe SSD, and right now, the only way to achieve that is by RAIDing two, already powerful, PCIe drives. Although, with X299, you can invest in Intel's on-processor RAID technology for a fee, it is, unfortunately, locked to its 600p drives, which, to be frank, pale in comparison to the likes of Samsung's 960 Pros. The chipset, however, still supports RAID 0, 1, 5, and 10, so the solution was simple: two 512GB Samsung 960 Pros in RAID 0 for the OS. On top of that, we can provide an additional 2TB of standard PCIe storage for any other programs or games we want.

For media storage, we decided to up the ante a little more, and opted for two, now almost ancient, 2TB Samsung 850 Pro 2.5-inch SSDs. We've set these up in RAID 0 again, to capitalize on that additional speed, and will be backing up all 7TB of storage on to our 10TB mirrored HDD array.

BUILD IT!
Step-by-step guide
PG. 72

HHD

HGST ULTRASTAR HE10

Speaking of hard drive arrays, why fix what isn't broken? HGST is now part of Western Digital, one of our favorite spinning platter brands, and these helium-filled 10TB 3.5-inch disks are some of the best in the business.

Setting this pair up in RAID 1 gives us a total of 10TB of mirrored storage, with plenty of redundancy, for an on-site backup of everything and anything on the system. And with their impressive sequential performance, backing up weekly or even daily shouldn't be too much of an issue, especially given the infrastructure residing within the rest of the system.

We had quite a debate in the office as to whether to include these or not. The Phanteks Enthoo Elite does have support for multiple HDDs in the bottom tray, although, in reality, we could only use two, because any more would impact on our liquid-cooling plans. And there's a certain noise element we're trying to avoid. Relegating these disks to backup drives, however, does neutralize the noise somewhat as, using incremental backups, these should only be operating for a small part of the day or week.

COOLING

EKWB LIQUID COOLING & CORSAIR ML FANS

As soon as we had confirmation of the parts we'd be featuring in our Dream Machine, we headed to EKWB's site to grab the very best liquid-cooling hardware. For us, nothing beats the clean, subtle look of EK's parts.

With the Core i9-7900X being notoriously hot under the collar, and those Titan Xps being no slouches either, we also needed some serious fan power to cool the loops, so we went with some of the best we've seen this year: Corsair's Mag Lev ML120 and 140 Pro series. With a huge RPM operating range, impressive static pressure figures, and a fantastic aesthetic, they're a no-brainer.

MOUSE
MIONIX CASTOR

Peripherals are a very personal thing. With multiple types of grip, and different hand sizes, use cases, and tastes in style, there's never going to be one perfect mouse for everyone. For instance, if you wanted a super-clean workstation, you might take advantage of a wireless implement—perhaps Logitech's MX Master. A true FPS gamer? BenQ Zowie's FK1 could be the ideal choice. Just want a solid mouse? Microsoft's Intellimouse is still kicking about on the world wide web.

For this Dream Machine builder, though, it's all about a clean, soft-touch finish, simple, sophisticated RGB lighting, and an ergonomic palm grip. All of that comes together in Mionix's Castor gaming mouse. And, ironically for Dream Machine, it's impressively affordable, with a pretty sweet PixArt optical sensor, too.

PSU
CORSAIR HX1200I & CABLEMOD CABLES

The choice of PSU this time around was an easy one to make: We went straight for Corsair's HX1200i. After using the 1,000W variant last year, and appreciating just how quiet it is with its 0dB fan tech, plus the fantastic Platinum energy efficiency rating, there really was no other choice.

We also went all-out this year and got in touch with CableMod to hook us up with some bespoke nylon-sleeved PSU cables. They're certainly not cheap, coming in at $311 for the lot, but the quality is exceptional, and with CableMod's cable combs, they really add some extra pop to your build. If you're after your own set of bespoke cables, head over to CableMod's store, select the configurator, then choose your model of PSU, add the cables you want, the material you'd like to use, and the color and length of the cables you need, and just add them to your cart. Simple.

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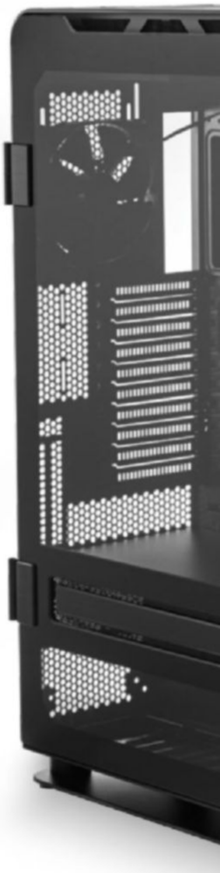
Step-by-step guide
PG. 72



CASE
PHANTEKS ENTHOO ELITE

The Enthoo Elite is undoubtedly the king of all full-tower cases. Coming in at a staggering $900, this compartmentalized leviathan has the potential to support both an ITX and an XL-ATX system simultaneously. Combine that with its class-leading liquid-cooling support and exceptionally premium build materials, and there's simply no argument about why we chose this case.

The Elite comes in its own flight case to protect its massive 66lb bulk (when empty). It has two sets of accessory kits, and supports up to 20x 120mm fans, or 17x 140mm fans (with five included).

Phanteks hasn't spared any expense with build materials, either, utilizing 4mm anodized sand-blasted curved aluminum, a powder-coated steel chassis inside, and 4mm tempered glass with mesh ventilation baked in. The list of features is almost endless, and the Enthoo Elite even comes with a five-year warranty.

AUDIO

BEYERDYNAMIC DT 1770 PRO & RAZER SEIREN PRO

For this year's audio solution, we've decided to separate the headphones and microphone into two separate components. Audio quality is crucial, and a good set of cans helps to immerse you in your music, media, and games. One of our favorite pairs of headphones is the beautifully crisp Beyerdynamic DT 1770 Pro. With 45mm Tesla neodymium drivers, an impedance of 250 ohms, and a frequency response of 5–40,000Hz, it provides the most perfect reference sound imaginable, with enough punch in the bass and crisp, clear trebles to make any HRA pumped through these a joy to listen to.

For our dedicated microphone, we've gone for the Razer Seiren Pro. Arguably Razer's best and most premium product, the three-cardioid-pickup design lends itself to a multitude of recording modes, looks great, and can be mounted on to the RODE PSA1 Boom Arm. Couple that with XLR output and a pop filter, and it's damn near perfect.

KEYBOARD

LOGITECH G413 CARBON

When we were first introduced to Logitech's Romer-G key switch, we weren't entirely sold on it. Being die-hard Cherry fans, it's difficult to lean away from the brand as a switch archetype. After all, the company is very well established, with a history of developing switches all the way back to the 1950s. However, Logitech's Romer-G has, over time, grown on us, and when combined with the absolutely fantastic aesthetic found on the G413 Carbon, it's hard to argue against it.

There's something about a crisp, brushed aluminum chassis that speaks to us. It's an aesthetic that leans away from the "I game, therefore it needs to be pointy" styling of other brands, and toward professionals who appreciate a good switch. It serves multiple purposes, and multiple types of people, and that's what, to us, defines a good product.

CHAIR

NOBLECHAIRS EPIC SERIES WHITE

There's nothing like having a premium gaming chair to plant your posterior on after a long day in the office. Noblechairs offers the high end of excess when it comes to gaming chairs, with models ranging from $300 to $650. Depending on your budget, you can net yourself an exceptional genuine or faux leather buttocks-hugger. We've tested a fair few fancy gaming stools, and Noblechairs has always come out on top for both quality and comfort.

Admittedly, it is hard to justify a bucket seat for an office environment, but Noblechairs' seats don't look anywhere near as garish as those of some of its competitors, and the new ICON series, yet to be released, capitalizes more on the office style ethos. For our Dream Machine, we've opted for this stunning white faux leather EPIC. Newly released, it's classy, comfortable, and fits right in with our desk setup this year.

CONCLUSION

OF DREAMS, NIGHTMARES, AND A WHOLE LOT OF DOWNRIGHT HARD WORK

BUILD IT!
Step-by-step guide
PG. 72

Summing up the concept of Dream Machine in a single sentence is difficult. It's a labor of love for those who work on it, often taking months to source the parts, plan the build, and finally construct the beast. But, in a lot of ways, it's impractical, implausible, and excessive in its ambition. We'd never, ever recommend you buy or build a system quite like it, because it's just not a feasible investment. That said, DM is a fantastic insight into what the very best of today's hardware can achieve.

Over the past few years, we've looked ever deeper into liquid cooling as an avenue of thermal venting for these monster machines, because it offers multiple benefits. Whether it's a reduction in noise, lower thermals, or higher overclocks, liquid cooling to this degree, for those who have the cash and the patience, is a no-brainer. On top of that, in the office, we collectively feel that Dream Machine should be a challenge.

But performance is the kingpin that holds this concept together, and all the cooling in the world does little if you're running a Pentium processor and an Nvidia GT 720. Luckily for us, then, Dream Machine 2017 comes rammed with the best hardware around.

Unsurprisingly, it demolished everything we threw at it. Whether that was processor or GPU-bound benchmarks, it destroyed our zero-point entirely—in some cases by nearly 500 percent.

It did lose out in a few areas, though. Our PCIe SSD M.2 RAID 0 array was excruciatingly lackluster, presumedly because we'd saturated the DMI between the chipset and the processor with those GPUs and three PCIe M.2 SSDs. And single-core performance is still lacking compared to its high IPC Skylake competition.

As far as cooling goes, Intel is still scrimping on the thermal interface material between the processor die and the heat-spreader, unfortunately. With 1.25V, you can see temps spike up to 80-90 C (still lower than a 240mm AIO), but as soon as the load drops, it's almost instantaneously back to idle temps.

Overall, though, Dream Machine 2017 is one burly beast of destruction, filled to the brim with the best the world has to offer, and we're exceptionally proud of it.

WATER-COOLING INGREDIENTS

PART		PRICE
CPU Block	**EK Supremacy EVO—Acetal + Nickel**	**$77**
Memory Heatsinks	**4x EK-RAM Monarch Module**	**$136**
Memory Blocks	**2x EK-RAM Monarch X4**	**$51**
GPU Blocks	**2x EK-FC Titan X Pascal—Acetal + Nickel**	**$278**
GPU Backplates	**2x EK-FC Titan X Pascal Backplate** (Black)	**$68**
Reservoir/ Pump	**2x EK-XRES 140 Revo D5 PWM** (Sleeved Pump) **+ 2x EK-RES X3 250**	**$459**
Radiators	**2x EK-CoolStream PE 480** (Quad)	**$218**
Hard Tube Fitting	**26x EK-HDC Fitting 12mm G1/4** (Black), **16x EK-HDC Fitting 12mm G1/4** (Black Nickel)	**$237**
90° Fitting	**6x EK-AF Angled 90° G1/4** (Black), **11x EK-AF Angled 90° G1/4** (Black Nickel)	**$135**
45° Fitting	**3x EK-AF Angled 45° G1/4** (Black), **10x EK-AF Angled 45° G1/4** (Black Nickel)	**$85**
Extender Fitting	**2x EK Extender G1/4** (Nickel)	**$5**
T-Splitter Fitting	**2x EK-AF T-Splitter 3F G1/4** (Black)	**$20**
Pass-Through Fitting	**10x EK-AF Pass-Through G1/4** (Black)	**$57**
Tubing	**6x EK-HD PETG Tube 10/12mm 500mm** (2pcs)	**$41**
Coolant	**3x Mayhems Aurora Coolant Premix Tharsis** (Red) **1L,** **2x Mayhems Pastel Coolant Premix Ice** (White) **1L**	**$158**
Total		**$2,025**

TEMPERATURE BENCHMARKS

CPU Idle Temp *(Celsius/Fahrenheit)*	22	72
GPU Idle Temp *(Celsius/Fahrenheit)*	27	80
CPU Load Temp *(Celsius/Fahrenheit)*	63	145
GPU Load Temp *(Celsius/Fahrenheit)*	37	98
OC CPU Idle Temp *(Celsius/Fahrenheit)*	91	196
OC GPU Load Temp *(Celsius/Fahrenheit)*	41	106

OVERCLOCK BENCHMARKS

Maximum Overclock Achieved *(GHz)*	4.6
OC Cinebench R15 Single *(Index)*	191
OC Cinebench R15 Multi *(Index)*	2,466

BENCHMARKS

	ZERO-POINT	DREAM MACHINE 2017
X265 Encoding *(fps)*	20.63	38.15 (85%)
Cinebench R15 Single *(Index)*	196	176 (-10%)
Cinebench R15 Multi *(Index)*	987	2,184 (121%)
Fry Render *(Seconds)*	221	94 (57%)
AIDA64 Memory Latency *(ns)*	58	71.8 (-24%)
CrystalDiskMark Sequential Read OS *(MB/s)*	1,895	3,207 (70%)
CrystalDiskMark Sequential Write OS *(MB/s)*	949	2,146 (126%)
CrystalDiskMark 4K Read OS *(MB/s)*	54.85	42.11 (-23%)
CrystalDiskMark 4K Write OS *(MB/s)*	171	179.7 (5%)
3DMark Fire Strike Ultra *(Index)*	3,922	12,971 (231%)
3DMark Time Spy *(Index)*	5,073	14,555 (187%)
PC Mark8 Creative *(Index)*	7,675	7,664 (0%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our test bed consists of an Intel Core i7-6700K clocked at 4.6GHz, 32GB of DDR4 @ 2,400, a Samsung 950 Pro 256GB PCIe SSD, and an AMD Radeon Fury X. All games were tested at 4K and 1440p at Ultra presets, with AA ramped up. Temperature tests were performed for five minutes, utilizing Prime95's Burn Test, and one instance of FurMark with AA at 4K.

1440P GAMING BENCHMARKS

	ZERO-POINT	DREAM MACHINE 2017
Total War: Attila *(Avg fps)*	27	94 (248%)
Far Cry Primal *(Avg fps)*	57	161 (182%)
The Division *(Avg fps)*	55	151 (175%)
Rise of the Tomb Raider *(Avg fps)*	25	109 (336%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our test bed consists of an Intel Core i7-6700K clocked at 4.6GHz, 32GB of DDR4 @ 2,400, a Samsung 950 Pro 256GB PCIe SSD, and an AMD Radeon Fury X. All games were tested at 1440p at Ultra presets, with AA ramped up. Temperature tests were performed for five minutes, utilizing Prime95's Burn Test, and one instance of FurMark with AA at 4K.

4K GAMING BENCHMARKS

	ZERO-POINT	DREAM MACHINE 2017
Total War: Attila *(Avg fps)*	14	47 (235%)
Far Cry Primal *(Avg fps)*	34	92 (171%)
The Division *(Avg fps)*	33	87 (164%)
Rise of the Tomb Raider *(Avg fps)*	9	54.4 (504%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

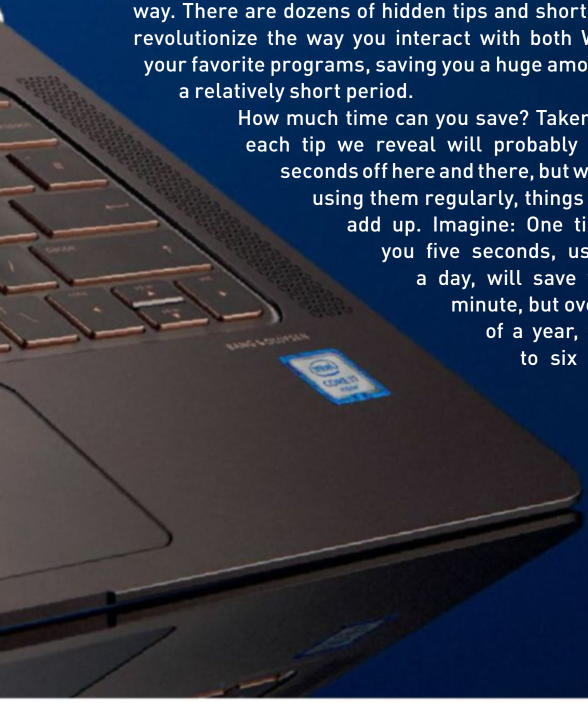
Our test bed consists of an Intel Core i7-6700K clocked at 4.6GHz, 32GB of DDR4 @ 2,400, a Samsung 950 Pro 256GB PCIe SSD, and an AMD Radeon Fury X. All games were tested at 4K at Ultra presets, with AA ramped up. Temperature tests were performed for five minutes, utilizing Prime95's Burn Test, and one instance of FurMark with AA at 4K.

Recently added
Jumplist Extender
Read me
License Agreement
Expand
Most used
Mozilla Firefox
Word 2016
File Explorer
MailWasherPro
Plex Media Player
Excel 2016
#
123 Free Solitaire
123 Free Solitaire
A
AACS Updater
Office and productivity
MoneyWiz
Simplenote
Family history
Family Historian
Family Tree Maker 2014.1
RootsMagic 7
TreeView
Play and explore
Xbox
Groove Music
Films & TV
XBOX LIVE
Microsoft Solitaire Collection
Photoshop Ex
Unpin from Start
Resize
More
Uninstall
Small
Medium
Search Windows

Pin and organize app shortcuts on the Start menu.

OPTIMIZE THE WAY YOU USE WINDOWS

Rethink how you use Windows 10 to speed things up. *By Nick Peers*



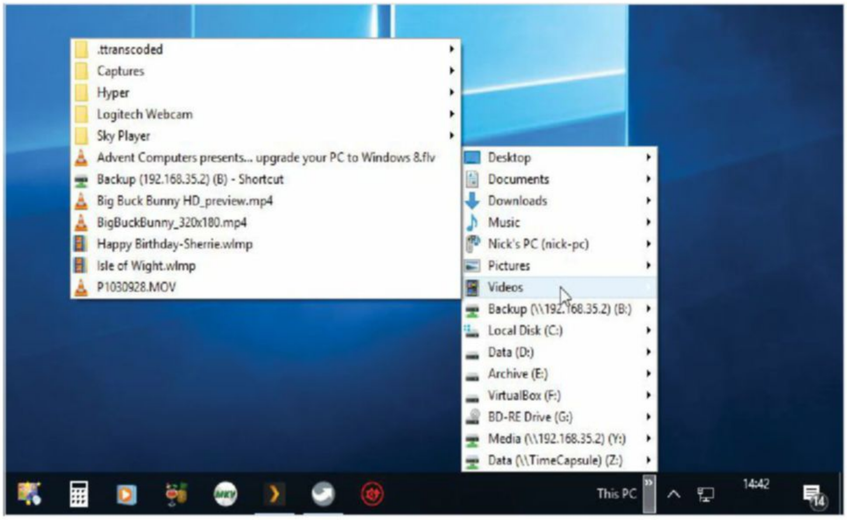
We all want our PCs to run faster, but that doesn't simply involve fitting a new processor, doubling the amount of RAM, or tweaking system settings in an effort to boost Windows' raw speed. It also involves reappraising the way you use your PC, finding new shortcuts, and basically forcing yourself to work in a more efficient way. There are dozens of hidden tips and shortcuts that can revolutionize the way you interact with both Windows and your favorite programs, saving you a huge amount of time in a relatively short period.

How much time can you save? Taken in isolation, each tip we reveal will probably shave a few seconds off here and there, but when you start using them regularly, things soon start to add up. Imagine: One tip that saves you five seconds, used 12 times a day, will save you a single minute, but over the course of a year, that adds up to six hours—from one tip. That means you don't have to apply that many of our recommended keyboard shortcuts and tweaks before your annual savings stretch into days and even weeks, simply by familiarizing yourself with the content of this feature.

We focused primarily on Windows 10 here, although many of the tweaks and tips also work with Windows 7 and 8.1. We optimize the way you use the desktop, Start menu (and its hidden little brother, the Quick Access menu), and Taskbar, plus reveal which Settings tweaks can streamline the way you work.

We also take you on a tour of timesaving keyboard shortcuts, investigate ways of using the right-click menu more efficiently, and unlock ways to search faster using File Explorer. There's even time to look at creating your own custom Jump List commands, reacquaint yourself with the Run dialog box, and speed up the way you use Microsoft Office (along with other apps).

With all that time waiting to be saved, don't delay—start implementing these tips now, and discover how to make your Windows PC even more productive.


.ttranscoded
Captures
Hyper
Logitech Webcam
Sky Player
Advent Computers presents... upgrade your PC to Windows 8.flv
Backup (192.168.35.2) (B) - Shortcut
Big Buck Bunny HD_preview.mp4
BigBuckBunny_320x180.mp4
Happy Birthday-Sherrie.wlmp
Isle of Wight.wlmp
P1030928.MOV
Desktop
Documents
Downloads
Music
Nick's PC (nick-pc)
Pictures
Videos
Backup (\\192.168.35.2) (B:)
Local Disk (C:)
Data (D:)
Archive (E:)
VirtualBox (F:)
BD-RE Drive (G:)
Media (\\192.168.35.2) (Y:)
Data (\\TimeCapsule) (Z:)
This PC
14:42

Access your entire PC's contents from the Taskbar.

Let's begin our efficiency drive by streamlining your desktop and making things more accessible. If you're not already doing so, start by placing shortcuts to your favorite apps on the Taskbar. This puts them a single click away—if you need to open a second instance of a program alongside the first, simply hold the Shift key as you click on the Taskbar icon to do so.

The simplest way to do this is to open the app in question—you'll see its icon appear in the Taskbar, so just right-click it, and choose "Pin to taskbar," then drag it into place. You might, for example, want to group related apps together, so office apps in one part, web apps in another, and so on.

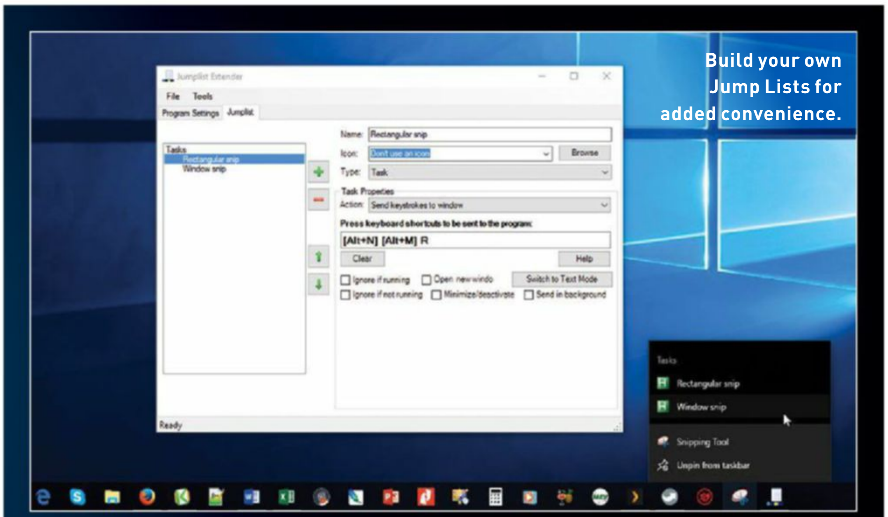
Another advantage to running apps from the Taskbar is that many use Jump Lists to give you two-click access to recently opened docs—right-click the Taskbar icon to access them all. To permanently attach an item to this list, roll your mouse over it, then click the pin button that appears.

If you run out of space for items on the Taskbar, you could create a folder inside which you place all your shortcuts, then right-click the Taskbar and choose "New → Toolbars → New Toolbar." Point it to this folder, then you can click the ">>" next to the newly created toolbar to access your shortcuts. Or go further, and create your own custom Jump Lists with the help of Jumplist Extender (see boxout on left).

Start Menu Shortcuts

The Windows 10 Start menu enables you to pin favorite items from the main list into the right-hand pane—just right-click the item in question, and choose "Pin to Start menu" (you can also pin the item to the Taskbar from here via the "More" sub-menu). Once it appears in the list, you can then drag and drop related items together, change icon sizes (regular program shortcuts can be small or medium), then name the group for easy identification (click the "=" button next to a group to rename it). Also, click and drag the title bar via its "=" button to reorder groups, placing your more frequently accessed groups at the top of the list.

You'll also notice some handy shortcuts down the left-hand side of the panel—click your user photo to quickly access account settings via the "Change account settings" option that appears (you can also switch users without logging out from here, too, plus lock your PC). Other shortcuts—including Settings and File Explorer—can also be found here. You have a limited choice of what you can display, including a selection of user folders (and indeed a link to the parent folder itself), Homegroup, and Network. To change these, navigate to


Name: Rectangular snip
Icon: Don't use an icon
Type: Task
Action: Send keystrokes to window
Press keyboard shortcuts to be sent to the program:
[Alt+N] [Alt+M] R
Jumplist Extender
File
Tools
Program Settings
Jumplist
Tasks
Rectangular snip
Window snip
Task Properties
Browse
Clear
Help
☐ Ignore if running
☐ Open new windo
Switch to Text Mode
☐ Ignore if not running
☐ Minimize/deactivate
☐ Send in background
Ready
Tasks
Rectangular snip
Window snip
Snipping Tool
Unpin from taskbar

Build your own Jump Lists for added convenience.

Create Custom Jump Lists

Extend your application Jump Lists with Jumplist Extender (https://code.google.com/archive/p/jumplist-extender)—despite its age, this open-source tool works perfectly with Windows 10. Simply select your program, then create app-related tasks you can add to the list of options that appear in the program's Jump List. The best news? Jumplist Extender edits the Registry to create and edit your Jump Lists, so it doesn't need to be running for them to work.

For example, launch the program, and choose "Start a new jump list." Type "snipping" into the "Search Programs" bar, and select the Snipping Tool. Click "Open" followed by "Run Snipping Tool" to launch the program. When it loads, click the Snipping Tool window to select it, then click "OK" in the Jumplist Extender window.

Type "Rectangular snip'" into the "Name" box in Jumplist Extender, then hold down Alt and press N— you'll see "Alt+N" appear in the '"Press keyboard shortcuts" window. Now press Alt-M, then press R on its own—it should now read "[Alt+N] [Alt+M] R." You can add other screen-capture options with the right key combo by pressing the green "+" button—for example, "[Alt+N] [Alt+M] F" for a Freeform snip, or "[Alt+N] [Alt+M] W" for a Window snip.

Once done, choose "File → Save and Apply to Taskbar." Pin the Snipping Tool shortcut to the Taskbar, and close the program. Now right-click its Taskbar icon, and you'll see the options you've created, enabling you to capture screenshots without having to open the Snipping Tool first.

You can then apply this technique to any other program using keyboard shortcuts to trigger tasks (if no direct keyboard shortcuts exist, see the main text for the Alt workaround). Jumplist Extender can also be used to create a custom list of files to open using the program in question.

"Settings → Personalization → Start," and then click "Choose which folders appear on Start."

Use Quick Access

The Start menu has been streamlined slightly in the Creators Update, but it's still no substitute for the Quick Access menu that appears when you right-click the "Start" button or press Win-X. This contains many useful shortcuts to various system settings and tools, but why stop with the options provided? You can add your own with the help of Win+X Menu Editor (http://winaero.com/comment.php?comment.news.30). This portable tool enables you to edit what's there, rearrange items, and—crucially—add your own.

Once launched, click "Add a program" to add your choice of programs, Control Panel items, or Administrative Tools. Select "Add preset" and you'll find some handy shortcuts to hidden tools and power options as well. You can also organize your items into groups to keep related items together, and make things easier to find.

More Settings Tweaks

The following tweaks all help save on clicks and unnecessary navigation, and can be found under "Start → Settings" (or use Win-I for even faster access). Start by heading over to "Devices → Mouse," and—if necessary—flicking the "Scroll inactive windows when I hover over them" switch to on. You can now roll your mouse over any open window and scroll it, without first selecting the window in question. If you're a trackpad user, click "Additional mouse options," and look for a tab that gives you access to specific gestures and other trackpad-only settings that can speed up how you use your PC.

If you regularly switch between printers, head to "Devices → Printer," and enable "Let Windows manage my default printer"—this makes whichever printer you use last the default. Select "Typing" if you want to disable autocorrect and remove text suggestions, although in most cases these are welcome timesavers. Finally, select "AutoPlay" if you want to pick a default option when you plug in external devices such as DVDs or flash memory cards.

Go to "System → Notifications & actions" to tweak which Quick Actions appear in the Action Center—useful shortcuts include toggling quiet hours and tweaking network settings. Then select "Multi-tasking" to change how virtual desktops behave—you can show open windows from all desktops on the Taskbar to speed things up if you frequently switch desktops, plus configure Alt-Tab to show all open windows, not just those open on the current desktop. More virtual desktop tweaks to come.

Go to "Accounts → Sign-in options" and set a device-specific PIN to save you time whenever you're asked for your Microsoft Account password. Finally, it's also worth exploring the "Ease of Access" section to see if any of the accessibility options on offer can improve your Windows experience to make things easier (and quicker) to use.

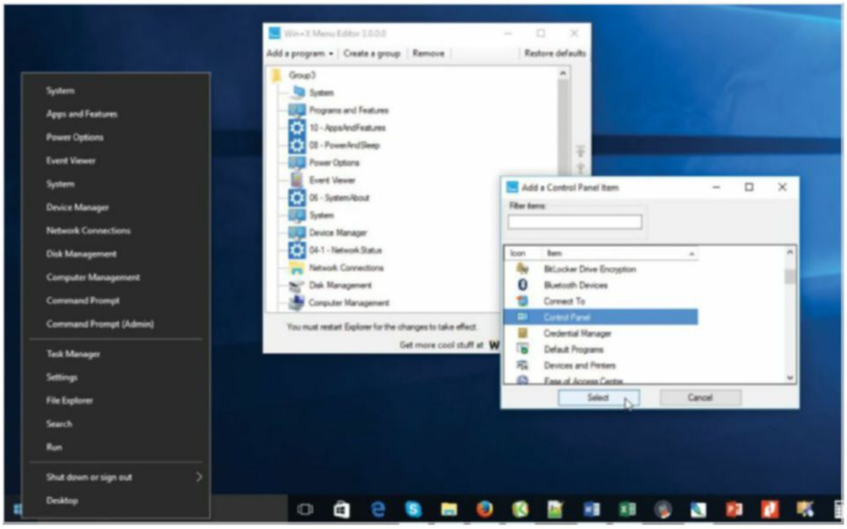
Master the Keyboard

Point and click is convenient, but it's no substitute for fast keyboard action. Assign keyboard shortcuts to your favorite programs to quickly launch them. First, examine the Taskbar: The first 10 entries to the right of the "Task View" button can be triggered using the shortcuts Win-1 through Win-0 (left to right). Alternatively, right-click a program shortcut (or right-click its Taskbar entry, then right-click the program entry in the Jump List), and choose "Properties." From here, click inside the "Shortcut key" box, then hold down your choice of key combo to launch the app—it needs to be Ctrl-Alt, Shift-Alt, or Ctrl-Shift-Alt plus your choice of key.

The Win key is also gateway to many useful tools: Win-Pause/Break opens the old System Control Panel, for example, while Win-A opens the Action Center. If you'd like to pair the Win key with Ctrl and Alt for more keyboard shortcuts, download WinHotKey from www.directedge.us/content/winhotkey, which works fine in Windows 10.

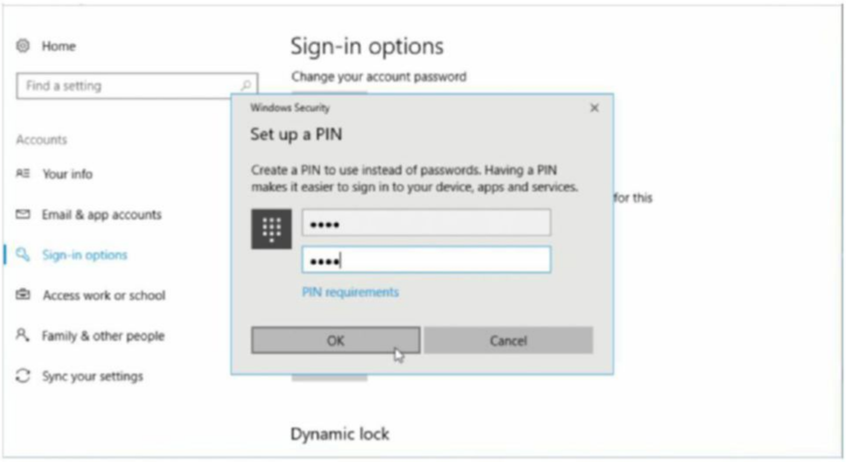
It's also worth exploring your favorite apps for useful keyboard shortcuts. There are some useful shortcuts universal to all apps (and Windows itself), such as the Ctrl-C, X, and V shortcuts for copying, cutting, and pasting to and from the clipboard. Ctrl-Z undoes the last action (including file operations in Windows), while Ctrl-Y redoes or repeats the last action.

Most keyboard shortcuts are clearly labeled within a program's menu, but


System
Apps and Features
Power Options
Event Viewer
System
Device Manager
Network Connections
Disk Management
Computer Management
Command Prompt
Command Prompt (Admin)
Task Manager
Settings
File Explorer
Search
Run
Shut down or sign out
Desktop
Win+X Menu Editor 3.0.0.0
Add a program
Create a group
Remove
Restore defaults
Group3
System
Programs and Features
10 - AppsAndFeatures
08 - PowerAndSleep
Power Options
Event Viewer
06 - SystemAbout
System
Device Manager
04-1 - Network Status
Network Connections
Disk Management
Computer Management
Get more cool stuff at
Add a Control Panel Item
Filter items:
Icon
Item
BitLocker Drive Encryption
Bluetooth Devices
Connect To
Control Panel
Credential Manager
Default Programs
Devices and Printers
Ease of Access Center
Select
Cancel

You must restart Explorer for the changes to take effect.

You can customize what appears on the Quick Access menu.


Home
Find a setting
Accounts
Your info
Email & app accounts
Sign-in options
Access work or school
Family & other people
Sync your settings
Sign-in options
Change your account password
Windows Security
Set up a PIN
PIN requirements
OK
Cancel
for this
Dynamic lock

Create a PIN to use instead of passwords. Having a PIN makes it easier to sign in to your device, apps and services.

••••

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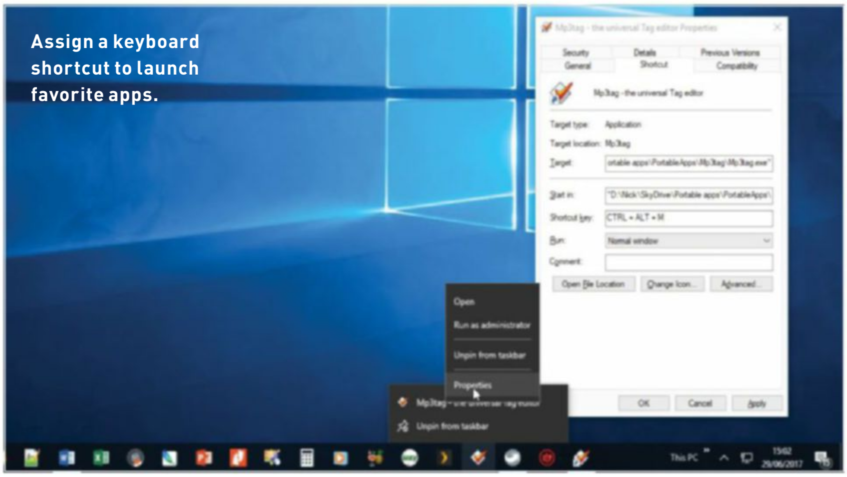
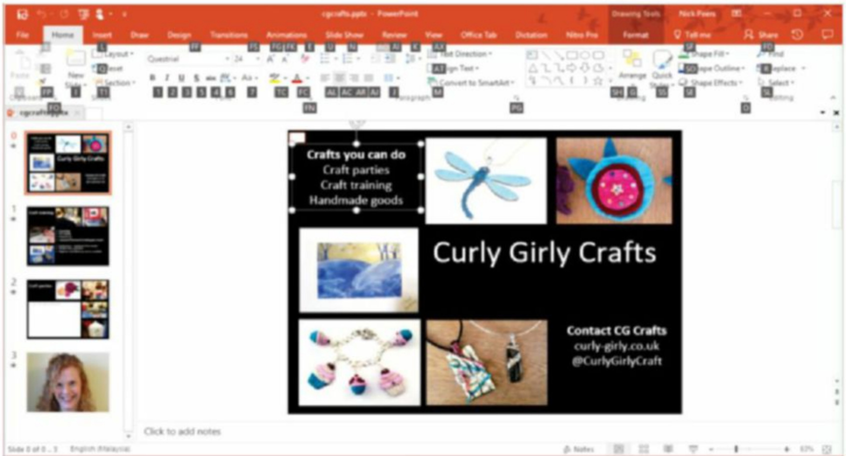
If you want to save time entering your password, use a PIN instead.



Assign a keyboard shortcut to launch favorite apps.

Target type: Application
Target location: Mp3tag
Shortcut key: CTRL + ALT + M
Run: Normal window



The Alt key accesses menus and ribbons alike.

where no shortcut is forthcoming, always remember the Alt trick—press Alt and the highlighted letter of a menu, and you open the menu. Combine this with the underlined letter of a specific menu option—Alt-F-O for "File → Open," for example—and you trigger that menu option.

Office 365 users should press Alt once—you'll see a list of letters appear above the various ribbon and Quick Access toolbar options. Hold Alt as you press the corresponding key to access that option—if it's a ribbon tab, more letters appear next to various ribbon options, enabling you to select those options quickly, too. For more Office tips, see the boxout opposite.

Use Right-Clicking

The right-click menu—also accessible by pressing Shift-F10 to trigger it at the current cursor point—is packed full of useful, context-sensitive options, particularly in File Explorer. Hold down Shift as you right-click, and you often reveal hidden options—for example, "Copy as path" for a selected file or folder, or loads more destinations under the "Send to" sub-menu.

To add your own custom apps and locations to the "Send:to" menu, open the Run dialog, type "shell:sendto" and hit Enter. Place your shortcuts in here, or use SendToToys (www.gabrieleponti.com/software) to add loads more options, such as clipboard, Command Prompt, and so on.

The right-click menus can become cluttered by third-party apps adding their

Use the Run Dialog

The old "Start → Run" dialog may not be shown by default on the Start menu anymore, but it's still there (press Win-R), and it's as useful as ever. The more you use it, the better it becomes, because autocomplete kicks in, while typing paths is also quick, because all available sub-folders pop up as you type, helping you to locate and travel through your filesystem that little bit quicker.

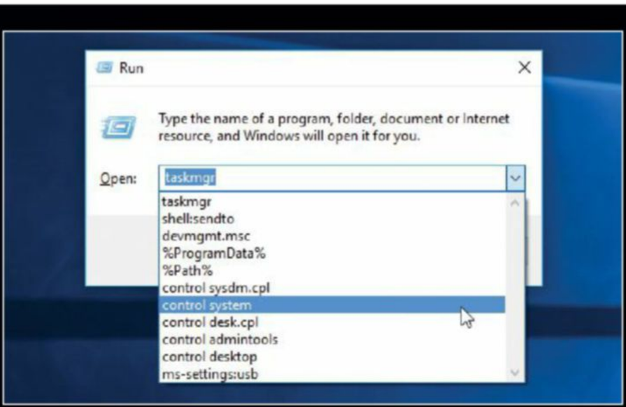
Let's start with a Windows 10-only tip. The new Settings menu can be labyrinthine to navigate, but the Run dialog gives you access to any section with the following syntax: "ms-settings:<shortcut>"

You need to replace "<shortcut>" with your choice of location, such as "ms-settings:windowsupdate," "ms-settings:lockscreen," or "ms-settings:display."

The Run dialog also speeds up access to the Control Panel, although many of the shortcuts now redirect to their Settings equivalent, such as "control desktop." Those that don't include "control admintools," "control system" (System Control Panel), and "control sysdm.cpl" (System Properties). See a full list at https://support.microsoft.com/help/192806/.

Others include "devmgmt.msc" (Device Manager), "taskmgr" (Task Manager), "cleanmgr" (Disk Cleanup), as well as any program shortcuts or program file names (such as "winword" for Microsoft Word).

One other major use for the Run dialog is to browse



Run

Type the name of a program, folder, document or Internet resource, and Windows will open it for you.

Open: taskmgr

```
taskmgr
shell:sendto
devmgmt.msc
%ProgramData%
%Path%
control sysdm.cpl
control system
control desk.cpl
control admintools
control desktop
ms-settings:usb
```

The Run dialog box is a timesaving superstar.

hidden user folders—specifically your application data folders. This is done with environment variables—"%AppData%" points to C:\User\<Yourname>\.AppData\Roaming, for instance, while "%LocalAppData%" redirects to C:\User\<Yourname>/.AppData\Local. Type "%AppData%\" and you see a list of sub-folders—keep typing, and they filter down until you can select one.

Other environment variables include "%windir%" (your Windows directory, typically C:\Windows), "%OneDrive%" (your OneDrive folder), and "%ProgramData%" (the location of the ProgramData folder).

own options, which can slow navigation down. If there's no option to disable these within the application itself, there are a few third-party tools that can help clear the clutter for you. If you're using CCleaner (www.piriform.com), then go to "Tools → Startup → Context Menu tab." If you want more control—including options for adding more entries to the menu—then use the portable Context Menu tool (www.sordum.org/7615/easy-context-menu-v1-6/) instead. Choose "File → ContextMenuCleaner" to review and scrub unwanted entries.

Speed Up File Explorer

File Explorer is packed with timesaving tips and tools. Here are some of the best. First, make use of the Quick Access menu in the Navigation pane—drag frequently accessed folders here for quick and easy access.

If you're still using Ctrl or Shift to select multiple folders or files, switch to the "View" tab of File Explorer's ribbon instead, and select "Item check boxes"—now you can simply select each file or folder by using its checkbox.

File Explorer's search box is still the go-to location for file and folder searches—learn to make the most of its filters to find what you need. The "Search" tab on the ribbon provides you with two-click access to these, but you can quickly input your own filters directly into the search box, including "type:" (filetype), "kind:" (type of file, such as document), "date:" (date or date range), "size:" (file size), and even "tag:" (tags).

The Search box also supports all standard Boolean operators, so enclose exact phrases inside double quotation marks, precede unwanted terms with a dash (-), and use AND, OR, or NOT. Visit https://msdn.microsoft.com/aa965711 for a comprehensive guide. If you store key files outside of your user folders, it's worth getting Windows to index those locations to speed up future searches. On the "Search" tab, choose "Advanced Options → Change indexed locations" to do so.

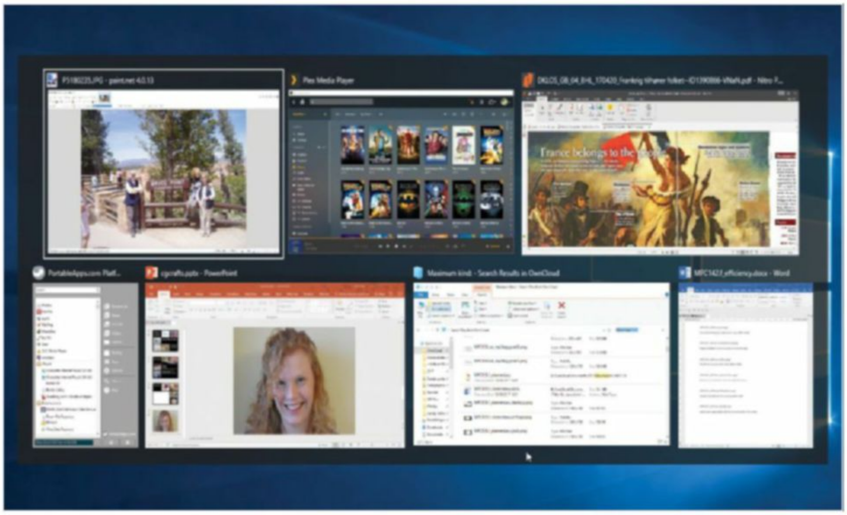
Windows Desktop

Let's finish with some handy keyboard shortcuts for navigating your desktop. Aero Snap enables you to pin two windows side-by-side by dragging them to either edge of the desktop. You can also snap windows via the keyboard: Hold Win and press left or right cursor keys respectively. Once there, press Win-up to move the window to the top corner, or Win-down to move it down to the bottom corner, allowing up to four windows to be on screen at once.

Finally, start making good use of Windows' task- and desktop-switching tools with the help of some Tab key combos. The new visual Task View may not be to everyone's tastes, but you can invoke it with Win-Tab. Once open, use the cursor keys to select your desired window, and hit Enter. If you prefer the old-school view, hold down Alt and press Tab instead—cycle left and right using Tab (right) and Shift-Tab (left), all while continuing to hold the Alt key.

Alt-Tab only displays windows from the current virtual desktop, while you can configure Task View (see earlier) to display windows from all desktops, making it quicker to switch. Speaking of which, hold Win-Ctrl-D to create a new virtual desktop, and Win-Ctrl-F4 to close the current one. Move between virtual desktops using Win-Ctrl-left/right cursor keys.

As an aside, if you're navigating a multi-tabbed application, such as your web browser, then use Ctrl-Tab and Ctrl-Shift-Tab to cycle backward and forward through the tabs. ⏻



Switch open apps quickly with the old-school Alt-Tab combo.

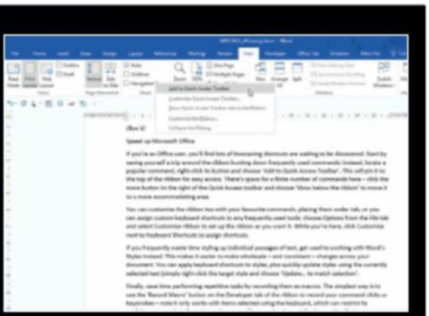
Speed Up Microsoft Office

If you're an Office user, you'll find lots of timesaving shortcuts are waiting to be discovered. Start by saving yourself a trip around the ribbon hunting down frequently used commands; instead, locate a popular command, right-click its button, and choose "Add to Quick Access Toolbar." This pins it to the top of the ribbon for easy access. There's space for a finite number of commands, so click the "More" button to the right of the Quick Access toolbar, and choose "Show below the ribbon" to move it to a more accommodating area.

You can customize the ribbon, too, with your favorite commands, placing them under a tab, or you can assign custom keyboard shortcuts to any frequently used tools: Choose "Options" from the "File" tab, and select "Customize ribbon" to set up the ribbon as you want it. While you're here, click "Customize" next to "Keyboard Shortcuts" to assign shortcuts.

If you frequently waste time styling up individual passages of text, use Word's Styles instead. This makes it easier to make wholesale—and consistent—changes across your document. You can apply keyboard shortcuts to styles, plus quickly update styles using the currently selected text (simply right-click the target style, and choose "Update... to match selection").

Finally, save time performing repetitive tasks by recording them as macros. The simplest way is to use the "Record Macro" button on the "Developer" tab of the ribbon to record your command clicks or keystrokes—note it only works with items selected using the keyboard, which can restrict its usefulness somewhat. Go to https://support.office.com and search for "macros" to find out more—be aware that macros can harbor malicious code, so only allow macros that are digitally signed, by clicking "Macro Security."



Place favorite commands on the Quick Access toolbar.

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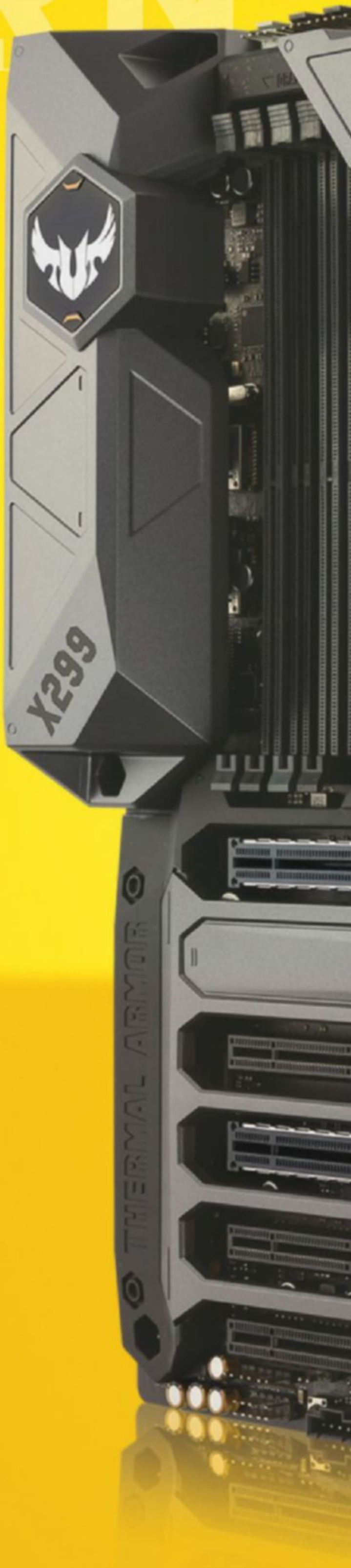
TECH PORN

Asus TUF X299 Mark 1

A NEW GENERATION, A NEW socket—that inevitably means new motherboards. And this generation is no different. Each time we get a new architecture, a new chipset, we see refined iterations of the brands and models we love. Whether it's Asus's prestigious ROG Hero and TUF Sabertooth motherboards, or MSI's ACK and EVGA's Classified series, there's always some new feature ready to be baked into a fresh design.

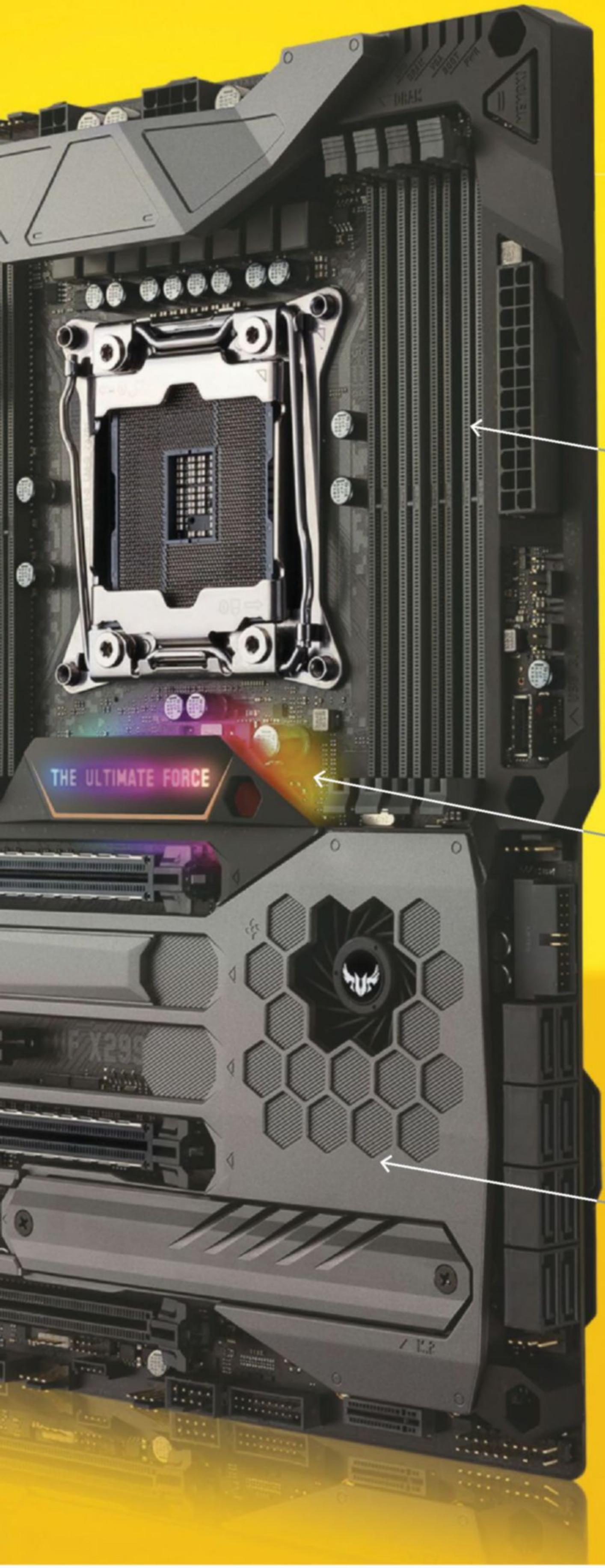
It's arguably one of the best parts of the modern tech industry. Not great for those looking for a cheap and easy upgrade, but for anyone building a fresh system, it ensures you're getting the very latest and greatest tech possible. X299 has been one of the more controversial releases from Intel, but the boards that have come along with it have been exceptional. Asus's TUF X299 Mark 1 is a fantastic example. Catering both to the high and low end, this plated and armored mobo comes packing integrated cooling, multiple PCIe lanes, subtle RGB lighting, a rear I/O cover, and fantastic onboard support for any number of interface devices.

It's also one of the cheapest motherboards currently available on the platform, making it fantastic value (relatively) for those wanting to build a super-clean system. If the armor isn't your thing, though, fear not, because the TUF X299 Mark 2 is available armor-free. **–ZAK STOREY**



1 REAR I/O

Rear I/O covers have become the norm for any premium motherboard. They hide any unsightly connectors, keeping your system looking tidy and clean. They also help reduce dust build-up.



2 DDR4 SUPPORT

Memory frequency on DDR4 seems to be increasing at an exponential rate. The Mark 1 can support kits with frequencies all the way up to 4,133MT/s, with 128GB of capacity.

3 RGB LEDS

Now this is how good mobo RGB lighting should be done. It doesn't look like a poor man's nightclub. It's simple and sophisticated, lighting up only the logo to anything that takes your fancy.

4 INTEGRATED COOLING

The TUF brand has always been known for its impressive cooling. Check out this integrated fan, designed to help cool the M.2 hidden under the armor below.

Home
Index
Playing
Starred
Departure
Capashen
Microdub-Nummer e...
Microdub
Bellevue
Misteur Valaire
BlueMoon VI FreeZone
PeerGynt Lobogris
You Can't Stop Da Fu...
demo.subsonic.org/main.view?id=134

STREAM EVERYTHING

Put it all online—your games, your media, your desktop, or even your life. *By Alex Cox*

WE'VE RELIED ON END-TO-END STREAMING for longer than we've relied on computers. Where would society be without the influence of radio or cable TV? Would we be quite the same if Major General George O Squier hadn't developed Muzak's earliest tech, a 1930s system of sending inoffensive music along electrical wires directly to elevators and stores? Well, probably. We might even be slightly more sane. But that's not the point: Streaming has long been hugely important, and the Internet has completely democratized it.

You're now free to send whatever you want wherever you want. You can push data, making it available to anyone who wants it, or pull streams, just for you, from a private source. You can work with audio, video, live cameras, or any other data that suits. You can use streaming for entertainment, for profit, or for practical benefits. And you can do it all, for the most part, for free. All you really need is a quality broadband connection on either end of the streaming path. You might not even need that, if your server hardware is robust enough to transcode media on the fly, converting it to a lower resolution that reduces bandwidth demands.

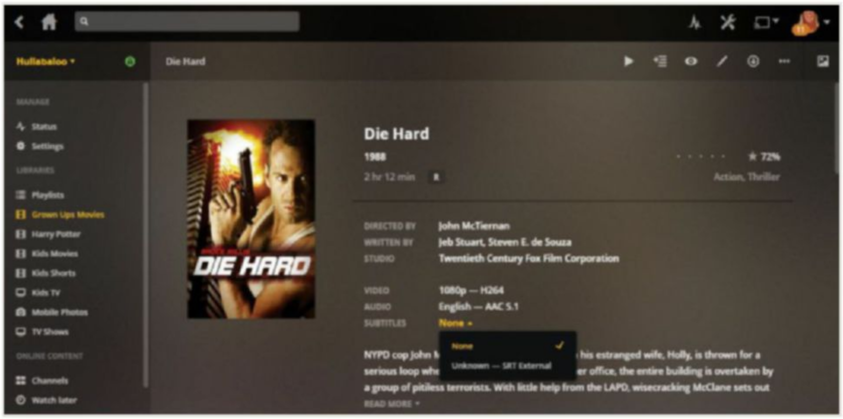
In this feature, we take you through as many different content streaming situations as possible, from games to sounds, and beyond. It's all very situational and personal. Everything you might want to stream has slightly different methodology, unique software, and technical considerations to take into account. Many of the tools we talk about can be used for more than one thing, and the specific one you use is, at the end of the day, up to you.

We talk public and private streaming, and give a few suggestions as to how to take advantage of the former to increase your online profile. While it's going to take a lot of work and a special kind of charisma to top Twitch's 200,000-viewer record for a single streamer—and, indeed, its all-time stream record of over 1,000,000 for a *CS:GO* tournament match—there's nothing stopping you from trying.

MEDIA LIBRARY STREAMING

Right off the bat, Plex Media Server is, by far, the slickest and cleanest solution for getting video and audio content that you own from a personal server on to basically any device anywhere in the world. Originally developed as a fork of XBMC (now Kodi), Plex has, over the past nine years, evolved into an extremely capable media host, which can look after everything from your music to your video content, and even, if you sign up for the monthly Plex Pass service, serve as a backup method for critical files such as photos. It offers apps for every major games console, and for cell phones and tablets, includes compatibility with the Google Chromecast and Amazon Fire Stick, and has a fully-featured web interface for everything else. The server itself can run on a number of devices—you may even be able to get it going on your NAS—but we recommend something solid. Check the "Right Hardware" box opposite to see the kind of gear you should be aiming for to get maximum performance.

Getting it set up is simple. Grab the appropriate installer for your device from http://plex.tv/downloads, and run it. It's a straightforward installer, no surprises. When it's over, you have to run through a bit of first-time setup in a browser window. This basically just involves creating an account on the Plex.tv website—Plex handles online translation and routing for you, which makes for vastly simplified remote streaming—and running through a few self-explanatory steps, including setting up a folder for your media. This can reside, realistically, wherever you'd like, although it's most efficient to use a drive directly connected to the computer that's running the server, because pulling from network storage in order to send media via the network doubles up the bandwidth required—unless you opt for the cloud option (part of the Premium package), which accesses content on storage providers such as Dropbox and Google Drive, and doesn't require a server PC at all.



Die Hard
1988
2 hr 12 min
★ 72%
Action, Thriller

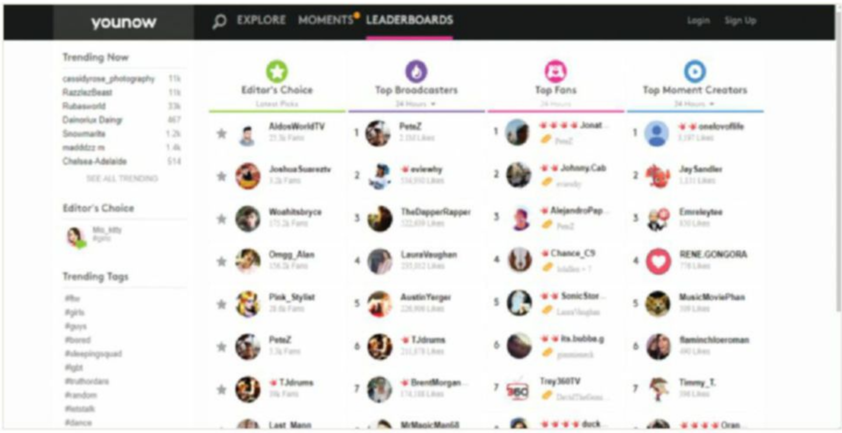
DIRECTED BY John McTiernan
WRITTEN BY Jeb Stuart, Steven E. de Souza
STUDIO Twentieth Century Fox Film Corporation
VIDEO 1080p — H264
AUDIO English — AAC 5.1
SUBTITLES None
None ✓
Unknown — SRT External

NYPD cop John M his estranged wife, Holly, is thrown for a serious loop whe er office, the entire building is overtaken by a group of pitiless terrorists. With little help from the LAPD, wisecracking McClane sets out

Plex does all the hard work of compiling covers and media information for you.

With everything in place, you have access to your entire media library from anywhere. Just sign in to the Plex client, on any device, with the credentials you set earlier, or head to http://plex.tv/web in a browser window. If your files are named correctly (see http://bit.ly/1Rxz8Ca), the server polls sites such as The Movie Database, Last.fm, and TheTVDB for thumbnails, episode information, and even trailers, and automatically arranges your media. Honestly, it's ridiculously easy, and compatible with just about every format—the most difficult thing you have to do is collect together and rip your media.

In theory, you have other choices if you're already tied into a different ecosystem. You could, with a bit of fiddling with SSH and VPN tunneling, make a Kodi library available online, or use VLC (www.videolan.org) to stream any kind of media locally. Alternatively, PlexBMC (http://bit.ly/2gCxAvq) can funnel the contents of a Plex media server into a Kodi client. Subsonic (www.subsonic.org) was designed solely for audio streaming, but also includes rudimentary video streaming capabilities, and works in a very similar way to Plex. And, hey, if you're happy to forget about controlling precisely what you can watch, you could always eliminate the worry of compiling a media library, and sign up for a dedicated streaming service such as Spotify, Netflix, Amazon Prime, et al.



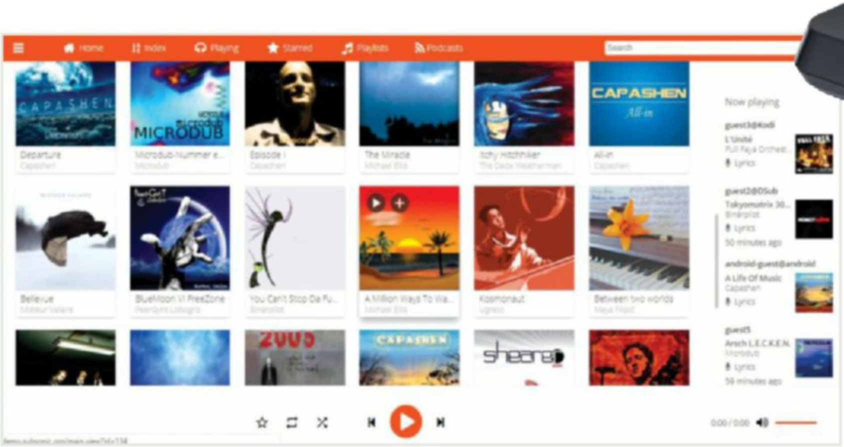
YouNow's leaderboards take streaming narcissism to new heights.

DESKTOP STREAMING

Now for something more practical: remote controlling your PC. There are several easy options for taking your desktop on the road, many of which have been around for a long time. VNC, for instance, is a well-seasoned open-source remote desktop client, highly configurable, with several different (but compatible) spins. Try TightVNC (www.tightvnc.com) or RealVNC (www.realvnc.com) if you're leaning in this direction; run the server app on the machine you want to access, and set a strong password—VNC's ports are, given that they offer up full access to your PC, often targeted by rogues.

Windows has a desktop streaming tool included in the form of Microsoft Remote Desktop, which can pick out individual apps from your desktop, and stream them seamlessly without the rest of it, and has client apps for phones and other operating systems. It's well featured and really rather good, but it's not our top pick. We're leaning toward something that, like Plex, does all the hard work for you: TeamViewer (www.teamviewer.com). It may be the most attractive among these tools in terms of the ease of its interface, and it's generally used for idiot-proof remote support purposes, but it's entirely feasible to set it up for easy access to your own hardware.

When you've downloaded and run its installer, select "Unattended." Now, when you first run TeamViewer, you're given a wizard to run through; you don't need to sign up for an account, you can use it anonymously if you choose. Note down the ID number you're given at the end of the process, and you can use it in conjunction with the password you set earlier to gain


Home
Index
Playing
Starred
Playlists
Podcasts
Search
Now playing

Subsonic's cover-focused interface looks a lot like iTunes—but it's slightly less irritating.

access to your desktop at any time, by using a TeamViewer app or through the website. The app also shows another password; it changes every boot, and you can give this to folks you want to be able to access your machine without knowing your login details.

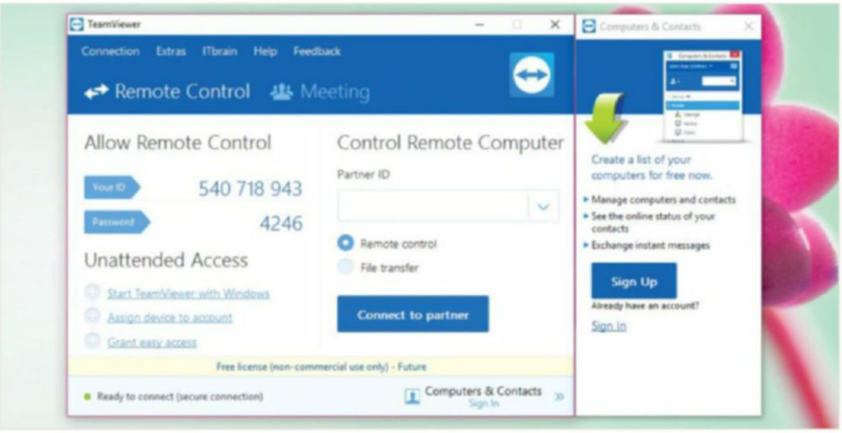
One thing to note: Streaming your desktop is generally much more demanding, and slower, than streaming a media collection, because your videos and audio have been encoded in a format that reduces their size and required bandwidth. TeamViewer and its ilk usually do some work to negate this, such as blanking your desktop background, dropping the color depth, and compressing the stream on the fly, but this does increase sluggishness. If you're trying to throw the raw contents of a 4K desktop down your Internet connection, don't expect to comfortably run graphically demanding applications, or for the experience to be the same as being sat at your desk.

If you want pinpoint control over the minutiae of your desktop streaming, there's an option you may not have considered: VLC media player. Set up a server by opening your desktop as a capture device, and switch from Play mode to Stream mode. Run through the wizard that appears, select the destination IP address of your stream, and use port 1234. You can now select the exact compression method you want to package your stream in, from encapsulation to video and audio codecs, by clicking the tool icon. It's a one-way street, so you can't take control with VLC itself, but it's an option.

GAME STREAMING

Games are the gaudy poster child of live streaming, and the topic most associated with the phrase. Given its proliferation, there are plenty of technologies and services associated with transporting gameplay from one place to another. If you're keeping it to yourself, look in the direction of Steam's In-Home Streaming service, which, with the minimum of effort, translates titles running on a powerful gaming PC into an h.264 stream, and fires them off to a client machine. As long as it's running Steam, this client can be equipped with almost any hardware—bringing beautiful games to the wimpiest laptop—though there are caveats to consider on the server end.

You need a machine powerful enough to render your game and quickly compress a video stream at the same time. Your server resolution is the maximum that


Your ID 540 718 943
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TeamViewer
Connection
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ITbrain
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Remote Control
Meeting
Allow Remote Control
Unattended Access
Start TeamViewer with Windows
Assign device to account
Grant easy access
Control Remote Computer
Partner ID
Remote control
File transfer
Connect to partner
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Ready to connect (secure connection)
Computers & Contacts
Sign In
Create a list of your computers for free now.
Manage computers and contacts
See the online status of your contacts
Exchange instant messages
Sign Up
Already have an account?
Sign In

Streaming your desktop with TeamViewer is easy—you just need two numbers.

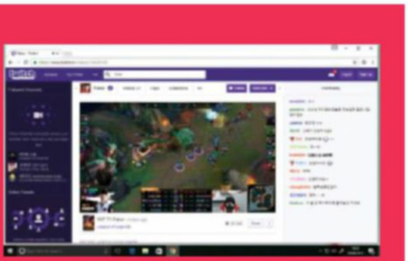
AVerMedia
EXTREMECAP U3

THE RIGHT HARDWARE

Streaming isn't usually very gentle on your hardware. Transcoding or encoding a video stream puts strain on your CPU, your GPU, and your RAM, so if you're looking for a smooth experience for your viewers, you should go as big as you possibly can to negate the overheads of putting that content online. Machines with more cores and threads tend to handle the task much better. Dedicate a machine to streaming if you can; use a device such as the Avermedia ExtremeCap U3 to pull in a 1080p signal over USB 3.0, then feel free to tax the machine you're creating content on, without fear of dropped frames.

That said, the most important asset of a good streaming machine is availability. If you're not performing otherwise demanding tasks—say, if you're only streaming your media collection—you can get away with a lot less, as long as your server is powered up and ready to go precisely when you need it. The best hosting hardware in this case is low-powered, low-noise, and able to be left switched on at all times. A specced-up Intel NUC, an old desktop tucked in an inconspicuous corner, an unloved laptop with its screen turned off, just about anything will do—and a cloud option, such as Plex, could be even better.

Regardless of whether you're streaming to one or to many, your server needs a quality network connection. Don't feel you'll be able to rely entirely on wireless, because high-res video puts big bandwidth demands on your hardware, and shaky connections, naturally, affect performance, so wire it up via Ethernet to a strong broadband pipe if you can. Avoid powerline Ethernet—we've found it has a tendency to go up and down at random—and opt for an Internet package with as much upload bandwidth as possible. It sounds obvious, but some just have the ratio all wrong.

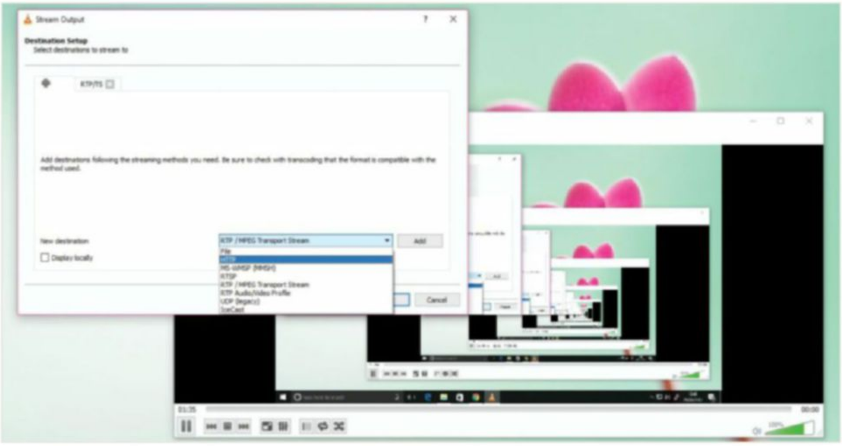


STREAM INTO THE BIG TIME

There are a lucky few out there who manage to make money from streaming. Only a few, though, so we don't recommend quitting your job just yet. It's hard to say what the prevailing source of income is for the average streamer; some make the bulk of their cash from tips and donations, which are often tied to shoutouts and on-screen recognition. This can work well, particularly for streamers with a growing audience, although those on the lower rungs often find this isn't enough to constitute a wage. A few also push Patreon subscriptions, although that's a system more associated with episodic content.

The key to making a living from streaming really seems to be the Twitch partner program, a mildly exclusive club reserved for regular streamers with a growing audience. You need to apply to join, and you absolutely must behave in terms of copyright, but when you're on the train, you share half of each $4.99 monthly subscription to your channel. Amazon's ownership of Twitch also helps; Amazon Prime subscribers get one subscription included with their account, so dedicated viewers may even be able to chip in (virtually) for free.

Getting to the peak, though? Aside from luck, there are a few key things to consider no matter what you're streaming. Be consistent with your schedule and quality. Be pleasant, approachable, and civil. Interact with your chat without scaring people away. Make sure your content is accessible—break it into manageable chunks on YouTube, and archive your broadcasts. Keep your image and audio quality high. Make friends with other streamers; they may host your channel when they are offline, which can drive attractive traffic your way. And, if you can stand it, pick a popular topic. Certain games do better than others—check Twitch for specifics. And, well, it also helps if you're highly attractive.



Add destinations following the streaming methods you need. Be sure to check with transcoding that the format is compatible with the method used.

VLC gives you plenty of options for streaming formats, so switch it up if one isn't working.

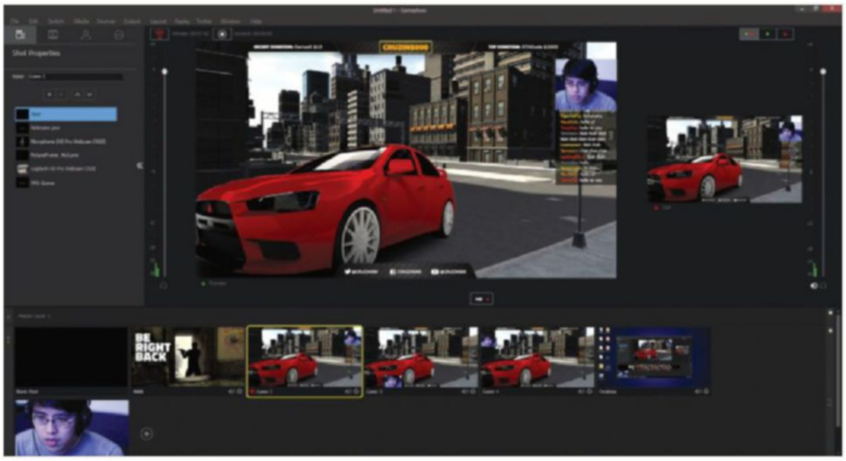
is replicated on your client, and that server needs to be actively running the game, so it can't be used for anything else while you're streaming. There's a small amount of lag, naturally, and while it's technically possible to use VPN trickery to run In-Home Streaming out-of-home, the additional delay makes your games all but unplayable. The same things are generally true for other stream playing experiences, such as Nvidia's Gamestream, which puts your GeForce-accelerated games on to Nvidia Shield devices, and third-party game streamers, such as Parsec and Remotr.

Game streaming comes into its own with one-to-many solutions, such as Twitch and YouTube Live, which take a stream from a client app—OBS is complex but free, XSplit comfortable but subscription-based, and Gameshow the new paid-for pretender—and send it online for anyone to enjoy. Microsoft is, as Microsoft does, sticking its own fingers in the pie, with Mixer (formerly Beam), which has the advantage of being built in to Windows 10 from the Creator's Update onward, and available from the Game bar, but the disadvantage of being, frankly, not very good. It'll grow, and it'll get better, but stick with the big boys for now.

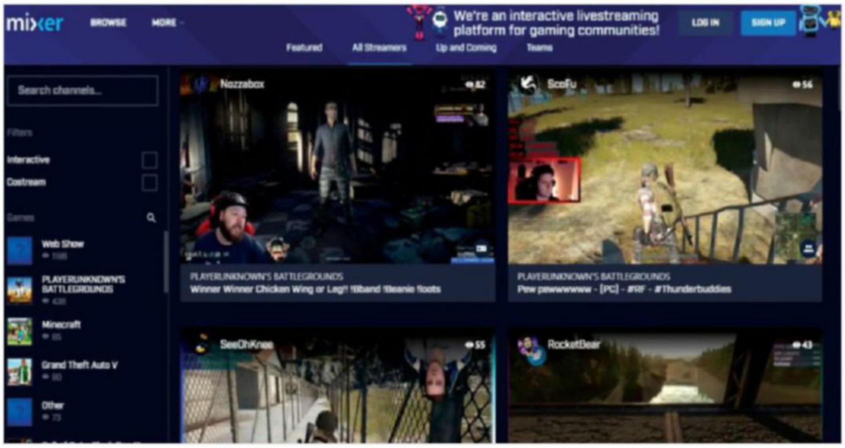
A few technical considerations: While it's possible to stream to the Internet from the PC you're playing on, that's often not the best idea. You're dealing with, potentially, far greater system overheads than in-home streaming, because you probably also want to process a video stream of your webcam and some sort of flashy overlay. Bigger streamers tend to split the load, with one machine managing the gameplay portion, and another equipped with an HDMI capture device and running the stream end, putting viewer interaction front and center.

PERSONAL STREAMING

While Twitch has long been the home of game streaming, it's recently taken a turn toward the personal, in the form of Twitch IRL channels. These move the focus away from games and on to the streamer, allowing for personal, often inane, vlog-style live streaming. Twitch's terms of service require that these include viewer interaction, follow strict guidelines, and don't deviate too far from the streamer as



You need a package such as Telestream's GameShow to ensure your broadcasts look sharp.



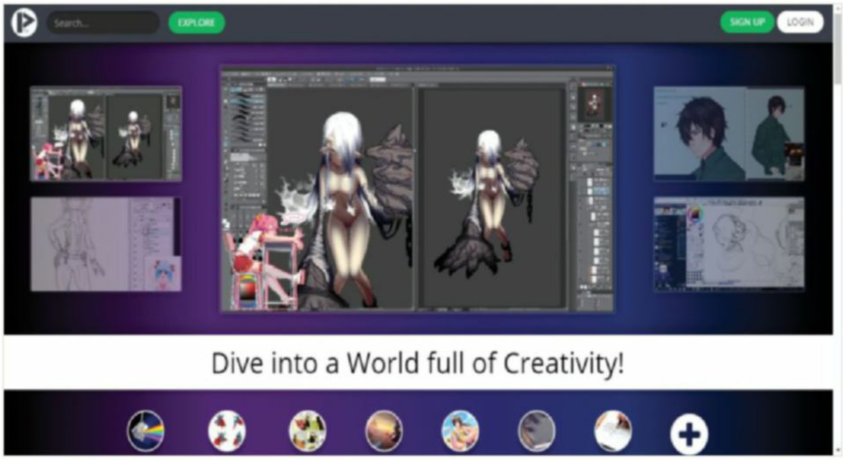
Microsoft's Mixer project is a relative newcomer, but you need no additional software.

the focus; the service also runs a talk show category, which caters for more subject-focused content.

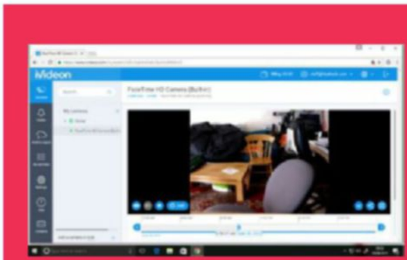
YouTube Live, accessible from its Creator Studio, is more flexible in terms of subject matter—you're free to stream whatever you like, as long as you don't offend any copyright holders—and includes lots of useful tools. Sign up with your Google account, and you are given a livestreaming permalink that you can share with potential viewers, and (with the help of OBS or similar) you'll soon be broadcasting. There's an included DVR feature, which lets viewers who missed the beginning of your broadcast jump back up to four hours. You can also stream directly from your phone, as long as you have an adequate cell connection and data plan.

There's a number of options for those who desire a more intimate audience. Facebook Live is growing in popularity, and getting up and running is as simple as penning a status, then hitting the live video option. You can, as with any Facebook post, set your privacy to public, and this is certainly a good option if you're using the broadcast functionality to push your brand, but bear in mind that you'll need to publicize public events if you want them to reach beyond your timeline. Justin.tv-style livecasting networks still exist, too; Ustream has been swallowed up by IBM, and now aims toward the corporate sector, but YouNow is increasingly popular, though it can lean toward Chatroulette and Omegle territory at times, and that's not somewhere any civilized person wants to be.

If you want to share a hobby rather than your personality, there are other niche streaming services. Twitch has a Creative category, which permits art, coding, music, and, occasionally, classic Bob Ross and Mr Rogers shows, although you wouldn't get away with broadcasting these yourself unless you're the rights holder. Picarto.tv caters specifically to artists, and has a long history and large community behind it. We should also mention Mixlr, which is perfect for audio streamers; you can use it to set up a virtual radio station, or create a live podcast recorded for later. It's not free—a full subscription with a permanent livestream URL will run you a cool $499 per year—but you can test it out with a trial. Happy streaming! ⏻



Pick up art tips or showcase your talents for drawing scantily-clad anime girls on Picarto.



SECURITY CAMERA STREAMING

You likely have a bundle of old cell phones or tablets hanging around, or can get your hands on some. So here's a little bonus streaming idea: Set one up as a security camera, and beam the goings-on of your household to wherever you happen to be. It may take a bit of creative mounting and wiring to put them in place—though the Dockem cell phone wall mount ($15) may be all that you need. The software side of things is actually remarkably easy; grab IP Webcam (Android, free) or iVideon (iOS, free) from your device's app store, run the app, point the phone's camera at the thing you want to watch, and install the appropriate client on your PC. VLC's stream capture function is enough for IP Webcam, while iVideon asks for its own server, downloadable from www.ivideon.com/get/.

That's only the tip of the iceberg, though. With multiple cell phone cameras, standard webcams—which you could hook up to any old streaming box with little overhead—or dedicated IP cameras, such as the $29.99 Wansview Home Camera, you can set up multiple simultaneous streams to a multi-cam server, such as the aforementioned iVideon or iSpy (www.ispyconnect.com). iSpy records footage to a hard drive, triggers itself with customizable levels of motion detection, and even alerts you to intrusions with a private video uploaded to YouTube. A subscription (from $7.95 per month) gets you access to your security camera network online, although there's nothing to stop you getting a little creative; why not stream your local cam server online using something like TeamViewer, for instance? It's absolutely less convenient, but a darn sight cheaper. Alternatively, you could always revert to iVideon, which gets you online access with limited features on its free plan, or more if you want to expand your coverage for a fee.

MASTER A NEW LANGUAGE

Guru Guide
Nobody goes deeper into technology
THE ULTIMATE JAVASCRIPT MANUAL 2017*
25 PRACTICAL TUTORIALS!
MASTER THE WORLD'S MOST IMPORTANT PROGRAMMING LANGUAGE
• EXPLORE JS FRAMEWORKS • DIVE INTO VR
• CREATE CUTTING-EDGE LAYOUTS
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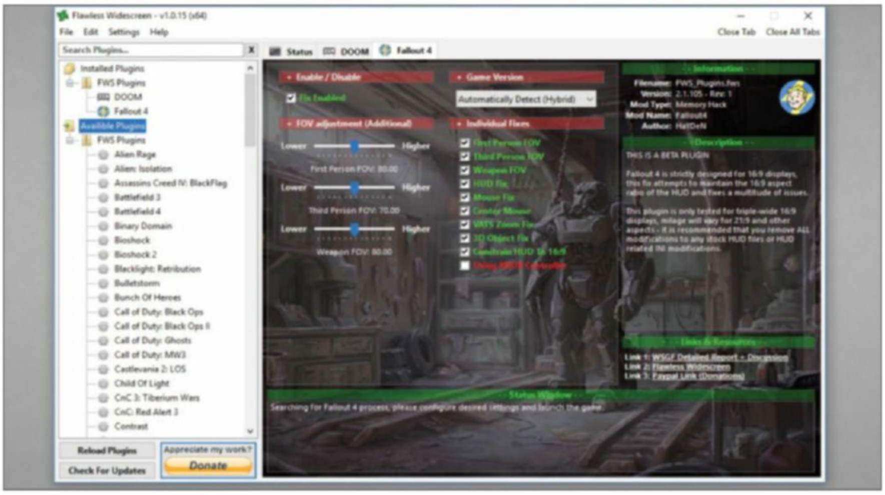
HOW TO

STEP-BY-STEP GUIDES TO IMPROVING YOUR PC

TIP OF THE MONTH


Flawless Widescreen - v1.0.15 (x64)
File Edit Settings Help
Close Tab Close All Tabs
Search Plugins...
Status DOOM Fallout 4
Installed Plugins
FWS Plugins
DOOM
Fallout 4
Available Plugins
FWS Plugins
Alien Rage
Alien: Isolation
Assassins Creed IV: BlackFlag
Battlefield 3
Battlefield 4
Binary Domain
Bioshock
Bioshock 2
Blacklight: Retribution
Bulletstorm
Bunch Of Heroes
Call of Duty: Black Ops
Call of Duty: Black Ops II
Call of Duty: Ghosts
Call of Duty: MW3
Castlevania 2: LOS
Child Of Light
CnC 3: Tiberium Wars
CnC: Red Alert 3
Contrast
Reload Plugins
Check For Updates
Appreciate my work?
Donate
Enable / Disable
Fix Enabled
Game Version
Automatically Detect (Hybrid)
FOV adjustment (Additional)
Lower Higher
First Person FOV: 80.00
Third Person FOV: 70.00
Weapon FOV: 80.00
Individual Fixes
First Person FOV
Third Person FOV
Weapon FOV
HUD Fix
Mouse Fix
VATS Zoom Fix
3D Object Fix
Constrain HUD to 16:9
Information
Description
Links & Resources
Status Window

Filename: FWS_Plugins.fws
Version: 2.1.105 - Rev: 1
Mod Type: Memory Hack
Mod Name: Fallout4
Author: HaYDeN

THIS IS A BETA PLUGIN

Fallout 4 is strictly designed for 16:9 displays, this fix attempts to maintain the 16:9 aspect ratio of the HUD and fixes a multitude of issues.

This plugin is only tested for triple-wide 16:9 displays, milage will vary for 21:9 and other aspects - it is recommended that you remove ALL modifications to any stock HUD files or HUD related INI modifications.

Link 1: WSGF Detailed Report + Discussion
Link 2: Flawless Widescreen
Link 3: Paypal Link (Donations)

Searching for Fallout 4 process, please configure desired settings and launch the game.

FLAWLESS WIDESCREEN

Running 21:9 or multiple monitors? Fed up with games not supporting the glory of 2560x1080 or 3440x1440? Tired of going into game config files to set the resolution to your new super-monitor? Then Flawless Widescreen is your jam. With a ton of plugins to automatically fix any resolution woes, this app makes using the niche aspect ratio a dream. It's freeware, so feel free to try it and donate at www.flawlesswidescreen.org.

ZAK STOREY
REVIEWS EDITOR

MIGHTY MONITOR ARM

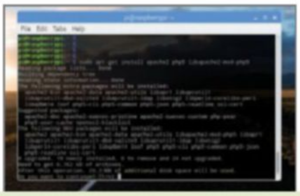
I love my man corner, but it could do with a spruce-up. The reclaimed wood and glass top look fine, but the overall setup would benefit from a shake-up. I intend to migrate to a new chassis sometime this year, with In-Win's recent foray into wooden-topped cases particularly catching my eye (more ITX AM4 boards, anyone?). But, apart from that, the biggy for me is the monitor.

I went out of my way to buy a Samsung CF791 earlier this year, managing to nab a B-grade sample from a retailer (allegedly returned because it was "too big" for the customer). Its 34-inch, 3440x1440, 100Hz, VA panel is a dream come true, and its beautifully crisp design makes it a joy to use. Problem is, the stand doesn't lend itself well to my desk, jutting out by almost seven inches.

It does, however, come with a rather odd VESA mount attachment (mounting to the integrated frame, rather than baked into the back of the panel), which may be the way forward. The stand is fairly rigid, so swapping it out for a monitor arm that can support its purported 13.4lb bulk, and be oriented in any direction I find appropriate, seems like the next logical step. For the moment, it looks like the AmazonBasics Single Monitor Display Arm will be the arm of choice. For $100, it checks all the boxes, and can take screens up to 25lb—more than enough for my CF791.

MAKE – USE – CREATE

60
Set up the perfect OwnCloud server for backup or sync



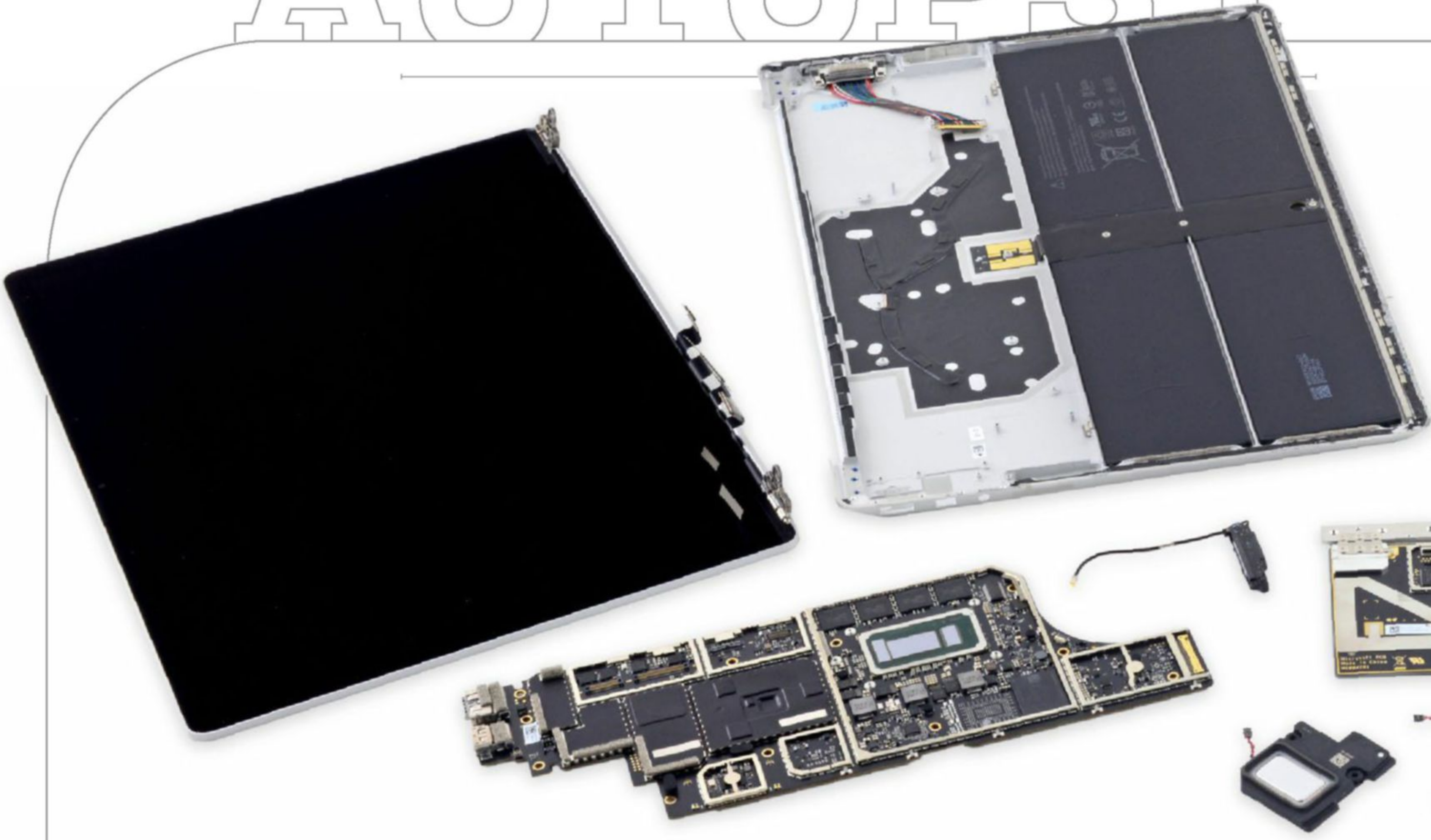
66
Use MediaWiki to create your own Raspberry Pi wiki

72
Discover how we built this year's Dream Machine

↘ submit your How To project idea to: comments@maximumpc.com

IFIXIT presents:

AUTOPSY



Microsoft Surface Laptop

That fluffy keyboard cover doesn't let go easily.

Nothing inside this laptop comes away without a fight.

About iFixit

iFixit is a global community of tinkerers dedicated to helping people fix things through free online repair manuals and teardowns. iFixit believes that everyone has the right to maintain and repair their own products. To learn more, visit www.ifixit.com.

Going under the hood of Microsoft's latest full laptop.

BACKGROUND:

Teardown is the word of the day, and we're diving into Microsoft's new Surface Laptop right now. Will this carpeted Alcantara-clad laptop excel in our teardown room? The power is in our hands.

MAJOR TECH SPECS:

- 13.5-inch IPS PixelSense display, 2256×1504 resolution (201 ppi)
- Intel Kaby Lake Core i5 (3M Cache, up to 3.1GHz), or Core i7 (4M Cache, 4.0GHz) CPU
- 4GB, 8GB, or 16GB RAM
- 128GB, 256GB, or 512GB PCIe SSD storage
- 720p front-facing camera with Windows Hello sign-in
- USB 3.0, Mini DisplayPort, and SurfaceConnect charging port
- 802.11ac Wi-Fi, IEEE 802.11 a/b/g/n compatible, Bluetooth 4.0

KEY FINDINGS:

- We take a peek under the suspicious rubber footpads on the bottom of the laptop, but find metal feet instead of the screws we were hoping for. Looks like we have to peel up that (dubiously luxurious) Alcantara after all. Jimmy in hand, we start popping clips and peeling adhesive. Already, this doesn't feel like it'll go back together. We try to remove the fabric cover, but the going gets a lot tougher south of the keyboard. We have to pull out the knife now, to cut off the rest of the pelt. Layered underneath, we find a metal shield—the meat in our Surface sandwich.
- With more adhesive and plastic bits holding the shield from beneath, we fire up the iOpener. Now we have a clear look at the plastic, it seems these aren't reusable clips at all, but weak ultrasonic spot welds that we've been busting through. This is definitely not going back together without a roll of duct tape.
- With the keyboard plate finally wrested free, we're at least pleased to see the long cable connecting it to the body. However, our pleasure is short-lived: The connector is trapped under a clip-on shield on the motherboard. With the keyboard out, we begin the search for the trackpad, and find it trapped under tape and a metal shield, but it's nothing we haven't handled before.
- We look for a battery connector to dispatch, but it's nowhere to be seen. Looks like we're doing this live! The Surface Laptop packs a 45.2Wh battery, roughly the same capacity as the latest Surface Pro (45Wh), and more than the iPad Pro 10.5-inch (31Wh) and latest MacBook Retina 41Wh).
- Also visible is a secondary heat pipe, helping dissipate heat from both sides of the mobo. The modular headphone jack is free to go, contacts and all. No Surface product is complete without a hinge, but these feel a little pedestrian. With that, the display is unhinged.
- Repairability Score: 0 out of 10 (10 is the easiest to repair). You can't get inside without inflicting a lot of damage. The CPU, RAM, and onboard storage are soldered to the mobo, making upgrades a no-go. The headphone jack can only be accessed by removing the heat sink, fan, display, and mobo. The battery is difficult and dangerous to replace, giving the device a limited lifespan.

Set Up the Perfect OwnCloud Server

YOU'LL NEED THIS

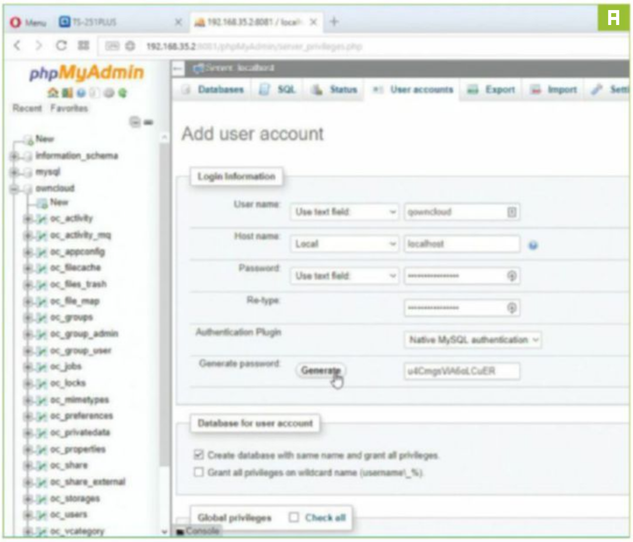
COMPATIBLE NAS WITH OWNCLOUD SERVER
For example, Western Digital Live, Synology, or QNAP.

LINUX-BASED SERVER
Plus, OwnCloud desktop and mobile clients.

CLOUD BACKUP AND SYNC is a brilliant way to ensure your data is both protected and available on all your devices. But you may have good reason not to want a third-party provider to look after your data—perhaps the cost is too great, you don't trust their encryption methods, or you'd rather restrict synchronization to your own network.

The solution to having your cloud-based cake and eating it is OwnCloud. OwnCloud works in exactly the same way as most cloud sync providers, but your data is stored locally, so the only limit is the size of your server's hard drive. It's also restricted to your local network by default—you can open it up, as we'll reveal, but if you're leery about making it available over the Internet, you can keep it closed off.

The most difficult thing about OwnCloud is setting it up, which is where we come in. If you have a NAS drive with the OwnCloud app, you can skip the tricky installation part (covered in detail back in issue 130), and get on with configuring and using OwnCloud to ensure your data is backed up, in sync, and secure. Read on to find out everything you need to know. **–NICK PEERS**


A
phpMyAdmin
Server: localhost
Databases
SQL
Status
User accounts
Export
Import
Settings
New
information_schema
mysql
owncloud
New
oc_activity
oc_activity_mq
oc_appconfig
oc_filecache
oc_files_trash
oc_file_map
oc_groups
oc_group_admin
oc_group_user
oc_jobs
oc_locks
oc_mimetypes
oc_preferences
oc_privatedata
oc_properties
oc_share
oc_share_external
oc_storages
oc_users
oc_vcategory
Generate
Console

192.168.35.2:8081/phpMyAdmin/server_privileges.php

Add user account

Login Information

User name: Use text field: qowncloud

Host name: Local localhost

Password: Use text field: ••••••••••••••••

Re-type: ••••••••••••••••

Authentication Plugin: Native MySQL authentication

Generate password: u4CmgsVlA6oLCuER

Database for user account

☑ Create database with same name and grant all privileges.

☐ Grant all privileges on wildcard name (username_%).

Global privileges ☐ Check all

1 INSTALL OWNCLOUD

Step one is—obviously—to install OwnCloud. If you're running a Linux-based server, download it from www.owncloud.org; if you're installing it on your NAS, visit its app center, or Google the NAS model and "owncloud" to see whether a community-built app has been produced, then follow the instructions to install it—typically, it's a simple case of clicking the OwnCloud icon or downloading a package, then uploading it to the NAS, which then does all the tricky installation stuff for you.

›› If you're a QNAP owner, you're stuck with OwnCloud 8.0.4, unless you're willing to jump through some pretty tricky hoops, or make do with just the basic database (which is impractical, as you'll see in the next step).

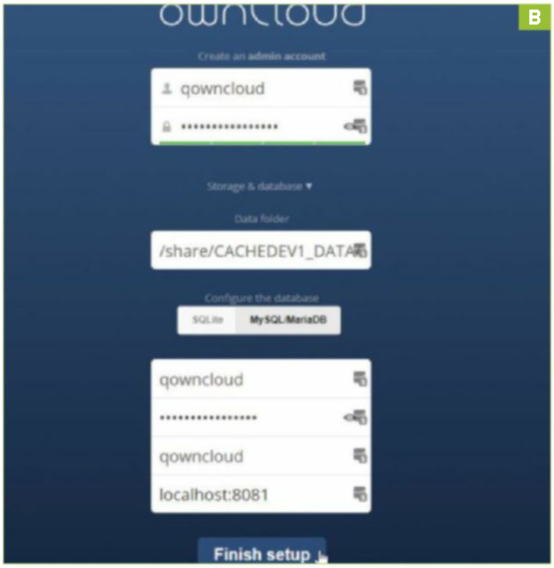
2 CONFIGURE MYSQL

Before launching OwnCloud for the first time, you need to set up a MySQL database for it to use. OwnCloud does ship with built-in support for SQLite, but by its own admission, this isn't very practical, and doesn't work with any desktop clients, so you need to upgrade. Any NAS supporting OwnCloud that's worth its salt should give you access to the phpMyAdmin app (or similar) to configure your new database.

›› If necessary, install phpMyAdmin through your app center, then select the app, and click "Configure" or "Open" to open it in a separate browser window. You then need to log into phpMyAdmin as the root user—if this is your first time, try "root" as the username and a blank password. Once logged in, start by clicking "Change password" under "General settings" to secure the account with a strong password—use the "Generate password" button, then save the generated password to your password manager (such as LastPass).

3 CREATE AND CONNECT TO DATABASE

Select the "User accounts" tab at the top of the screen. Click "Add User Account" to create a new user—say, "owncloud." Change "Host name" to "Local." Next, set a strong password by clicking "Generate" [**Image A**] (make a note of this, or save it to your password


owncloud
B
Create an admin account
Storage & database ▾
Data folder
Configure the database
SQLite
MySQL/MariaDB
Finish setup

qowncloud

••••••••••••••••

/share/CACHEDEV1_DATA

qowncloud

••••••••••••••••

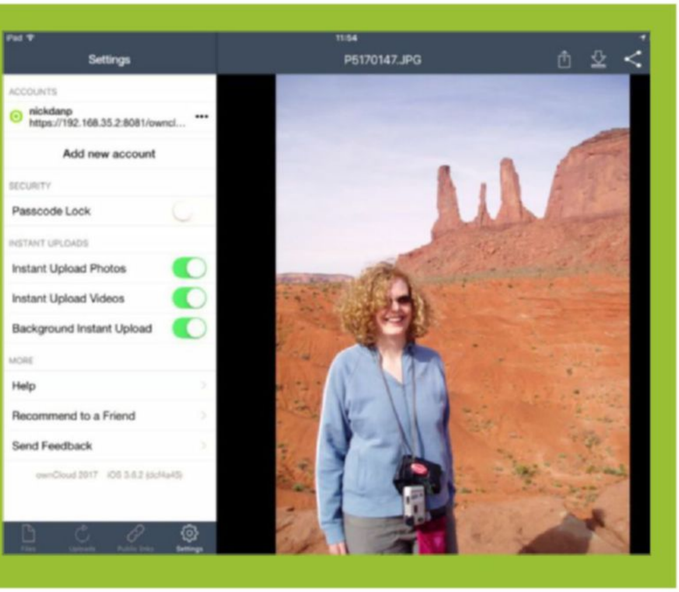
qowncloud

localhost:8081

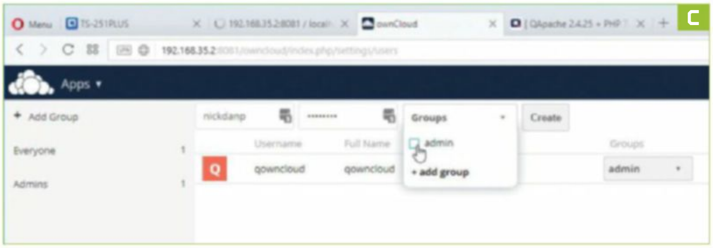
ACCESS FROM YOUR MOBILE DEVICE

There are mobile apps for iOS (99 cents), Blackberry (free), and Android (99 cents). Again, connect using your server address, username, and password. The app makes it easy to access your files on the go—you can view photos, stream video, and download files to your mobile storage. Go into Settings, and you can also automatically upload photos and video to your OwnCloud storage, too, plus set a PIN passcode to further protect your data.

You can also upload other files to OwnCloud from other mobile apps by looking for the option to send or share the file via another app—select "OwnCloud" from the list (if it's not present, scroll right, and tap "More," then flick the slider next to "OwnCloud" to "On"). From here, tap "Location" at the bottom of the screen to choose which folder to upload the file to, then tap "Upload to." You then need to open the OwnCloud app for the transfer to take place.


Settings
P5170147.JPG
ACCOUNTS
nickdanp
https://192.168.35.2:8081/owncl...
Add new account
SECURITY
MORE
Help
Recommend to a Friend
Send Feedback
ownCloud 2017 iOS 3.6.2 (dcf4a45)
Files
Uploads
Public links
Settings

Passcode Lock ○
INSTANT UPLOADS
Instant Upload Photos ●
Instant Upload Videos ●
Background Instant Upload ●


C
Menu
TS-251PLUS
192.168.35.2:8081 / local
ownCloud
[QApache 2.4.25 + PHP
192.168.35.2:8081/owncloud/index.php/settings/users
Apps
Add Group
Everyone 1
Admins 1
nickdanp
Groups
☐ admin
+ add group
Create
Username
Full Name
Groups
Q
qowncloud
qowncloud
admin

manager). Check "Create database with the same name and grant all privileges," then scroll down, and click "Go."

›› Once done, switch to the "Databases" tab to verify the OwnCloud database has been created. Click "Check privileges" next to it to verify there's an entry for your username—it should read "localhost" for "Host name," "database-specific" for "Type," and be given all privileges (but not able to grant additional privileges). Once verified, close the phpMyAdmin window.

4 FINISH CONFIGURING OWNCLOUD

Return to your NAS's app center, locate OwnCloud, and click "Open." First, create an administrator account for configuring OwnCloud—make sure its username and password matches the MySQL username password you created previously. Once entered, click the "Storage & database" drop-down menu, and select the "MySQL/MariaDB" tab. Enter your MySQL username and password again, then put the MySQL username in the "Database name" field, too, and change "localhost" to "127.0.0.1:12345," replacing "12345" with the port number displayed in the Address Bar next to your NAS's IP address. Click "Finish setup" [**Image B**].

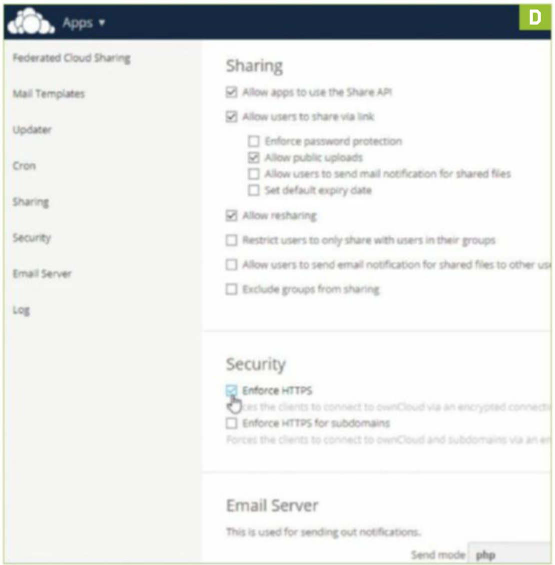
5 SET UP USER ACCOUNT

After a short pause, the main OwnCloud screen appears, with handy links for obtaining the desktop and mobile clients, plus instructions for synching calendar and contacts from your smartphone. Click the close button. You'll see a small list of folders and files have been created for the current user—your administrator, so to speak. Let's start by creating a dedicated user account for yourself: Click the down arrow next to your username in the top right-hand corner, and click "Users."

›› Now type a more memorable username and password into the boxes—you can make yourself a member of the admin group by clicking "Groups," and checking the "Admin" box if you wish [**Image C**]—however, for maximum security, it's best to leave administrating OwnCloud to the master user. Either way, be sure to protect your account with a strong password. Click "Create."

6 ADD MORE USERS—IF REQUIRED

If you plan to share your personal cloud with other household members, set up their user accounrs now—but don't make anyone an admin. If you plan to set different sharing privileges for different users, click "Add Group" to create groups that you can place people into. Make a note of the "Quota" drop-down menu—this enables you to set limits on how much data people can store using OwnCloud, which may be crucial if your NAS drive isn't particularly big. Options include unlimited, 1GB, 5GB, and 10GB, plus a custom option for setting your own limit in gigabytes. Think about how much space you have, and how you would like to divide it up among the users—50GB each should be more than ample for most people.


D
Apps
Federated Cloud Sharing
Mail Templates
Updater
Cron
Sharing
Security
Email Server
Log

Sharing

☑ Allow apps to use the Share API
☑ Allow users to share via link
  ☐ Enforce password protection
  ☑ Allow public uploads
  ☐ Allow users to send mail notification for shared files
  ☐ Set default expiry date
☑ Allow resharing
☐ Restrict users to only share with users in their groups
☐ Allow users to send email notification for shared files to other us
☐ Exclude groups from sharing

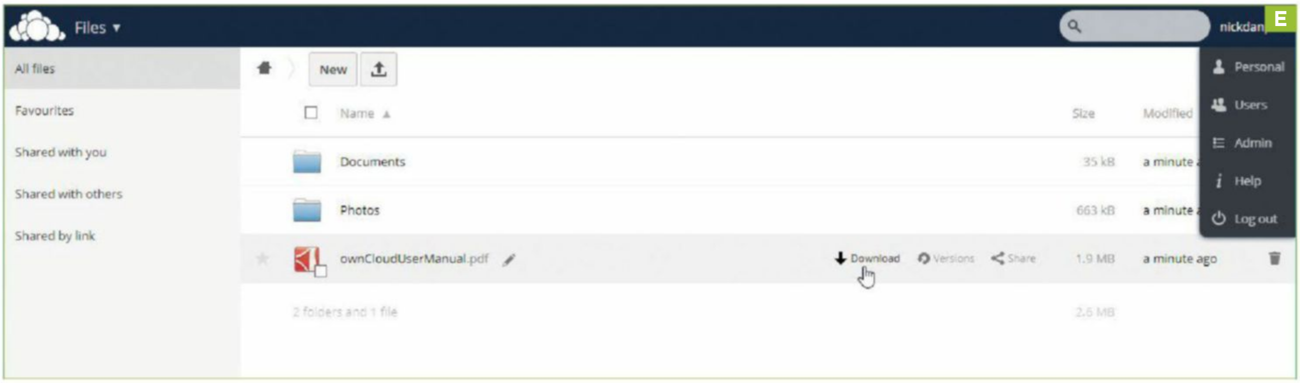
Security

☑ Enforce HTTPS
ces the clients to connect to ownCloud via an encrypted connecti
☐ Enforce HTTPS for subdomains
Forces the clients to connect to ownCloud and subdomains via an en

Email Server

This is used for sending out notifications.

Send mode php



Name ▲	Size	Modified
Documents	35 kB	a minute
Photos	663 kB	a minute
ownCloudUserManual.pdf	1.9 MB	a minute ago
2 folders and 1 file	2.6 MB	

7 SOME INITIAL TWEAKS

Before we switch attention to setting up your account, let's configure some settings. Click the account username in the top right-hand corner, and choose "Admin." Work your way through the options offered—you can restrict sharing to this OwnCloud server only, plus allow other users to only share within their user groups, for example.

›› We strongly recommend you check the "Enforce HTTPS" boxes to ensure all connections are secure [**Image D**]. Note your NAS or server needs to have an SSL certificate applied to it—see the boxout on the right for some tips. It's worth noting that OwnCloud's built-in security isn't perfect, particularly on older versions, but it's a start.

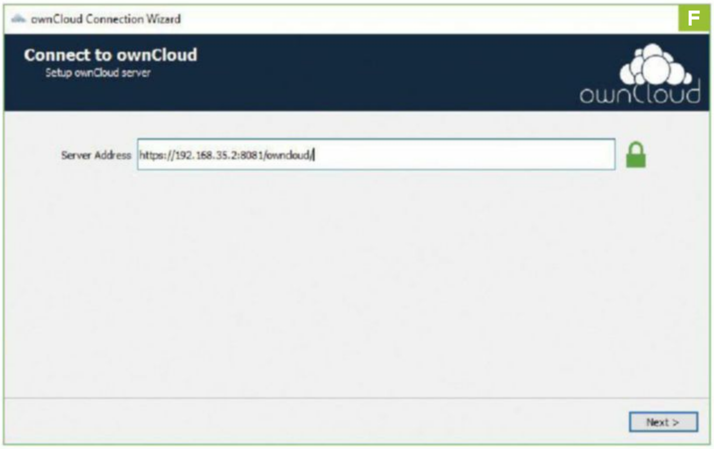
8 SWITCH TO NEW USER

Click the username drop-down menu in the top-right corner, and choose "Log out." Log in using your newly created account credentials to access your own personal cloud folder—files and folders can be created, uploaded, or deleted direct from here when you need to, although in most cases you'll use the desktop client to stay in sync. You'll see options on the left for favoriting files and folders, plus sharing them with others. Highlight a file in the list, and you'll see options for sharing and downloading it [**Image E**], plus "Versions"—OwnCloud can store multiple versions of a file, enabling you to roll back should you need to.

9 CONFIGURE DESKTOP CLIENT

If you've not already done so, download and install the OwnCloud client on your desktop or laptop—it's broadly the same process on Windows, Mac, and Linux, but we'll focus on the Windows client. When you launch it for the first time, you are prompted to connect to your server [**Image F**]—use the following syntax to do so:

```
https://192.168.0.2:8081/owncloud
```



Server Address https://192.168.35.2:8081/owncloud/

›› Substitute your NAS's IP address and the port number assigned to OwnCloud, and ensure it's an https:// connection. Click "Next." You get a message about an untrusted certificate, so ensure it's correct, check "Trust this certificate anyway," and click "OK." Enter your OwnCloud username and password, and click "Next."

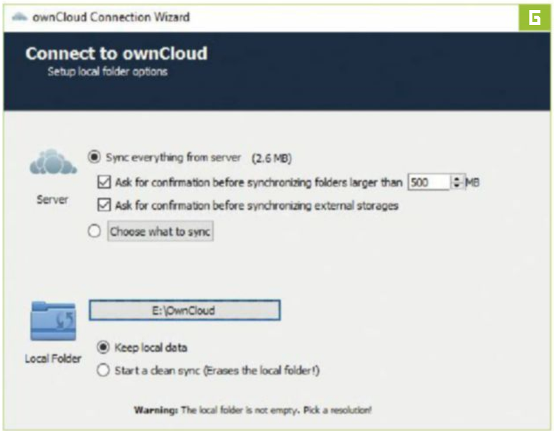
10 LET'S GET SYNCHED

Choose your sync settings—click the user data folder to choose a different location. If it already contains data, be sure to select "Keep local data," so it's synched to your server. You can choose to sync everything from the server, or selectively sync certain folders only [**Image G**]; you can also opt to receive confirmation before synching anything over a certain file size (500MB by default). Once done, click "Connect," and OwnCloud starts to sync. Two buttons let you access OwnCloud through your browser or the local folder you're synching to, but you can ignore these; click "Finish."

11 TRACK PROGRESS

Click the "^" button next to the Taskbar Notification area, and you'll see the OwnCloud cloud icon is now present. Click this to open the OwnCloud status window, where you can use the buttons to track the progress of your file sync. Click your username for an overview and to browse folders that have been uploaded (you can also selectively choose folders to sync from here, too, should you wish). A handy link to the OwnCloud browser configuration page is also accessible.

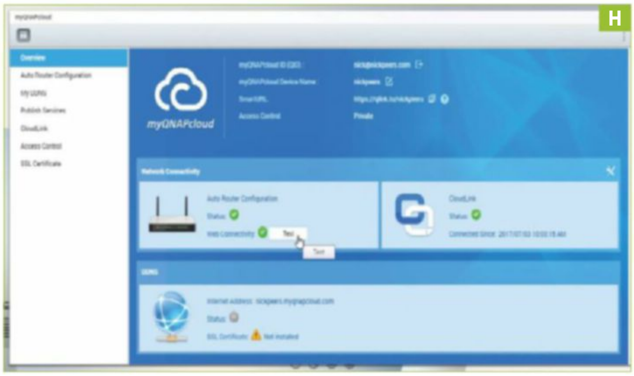
›› The "Activity" button enables you to get an overview of activity—use "Sync Protocol" to review the latest changes, while "Not Synched" provides you with a list of files waiting



● Sync everything from server (2.6 MB)
☑ Ask for confirmation before synchronizing folders larger than 500 MB
☑ Ask for confirmation before synchronizing external storages
○ Choose what to sync

E:\OwnCloud
● Keep local data
○ Start a clean sync (Erases the local folder!)

Warning: The local folder is not empty. Pick a resolution!


H
myQNAPcloud
Overview
Auto Router Configuration
My DDNS
Publish Services
CloudLink
Access Control
SSL Certificate
Network Connectivity
Auto Router Configuration
Status
Web Connectivity
Test
CloudLink
Status
DDNS
Status
SSL Certificate
Not installed

to be uploaded or downloaded. The "General" button provides you with access to client settings, such as enabling desktop notifications, and whether OwnCloud should automatically start with Windows. Use the "Network" tab to apply bandwidth limits to upload and download speeds—we recommend ensuring there are no limits during the initial sync, particularly if you have a large amount of data to upload to the OwnCloud server.

» Remember, you can install the OwnCloud client on all your desktops and laptops—repeat steps 9–11, and you'll soon have data synching between all your computers, with a backup copy residing on the server or NAS.

12 WIDEN YOUR ACCESS

As things stand, a locally installed OwnCloud server is only accessible through your home network. That's good from a security point of view, but you may have reasons for wanting to be able to access your data or sync while outside your home network. To do this, you should first sign up for a Dynamic DNS (DDNS) service. Your NAS manufacturer may offer such a service (QNAP users should check out myQNAPcloud, for example [**Image H**]), or you can sign up with a third-party service, such as www.no-ip.com, that's supported by your router. If you choose the latter option, you need to configure your router for remote access—if possible, force secure connections, and change the router password to something stronger. Also consider strengthening your NAS's protection—switch on two-factor authentication, for example, to prevent drive-by hackings.

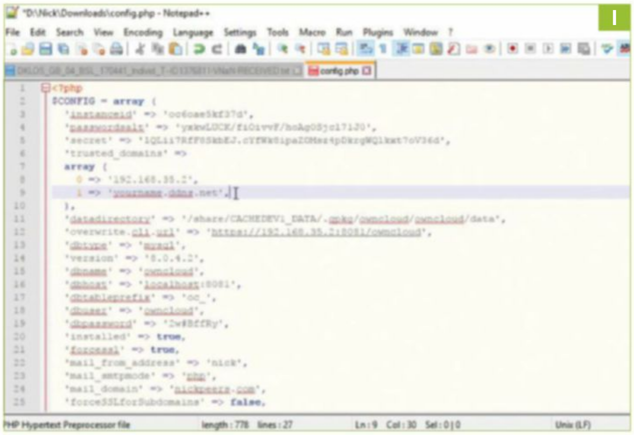
13 CONFIGURE DDNS AS TRUSTED DOMAIN

Once set up in your router, open your web browser and type the following: "https://yourname.ddns.net:8081/owncloud/" substituting "yourname.ddns.net" with your dynamic DNS address, and "8081" with the port you use to connect to your OwnCloud server locally. You're shown a message telling you that you're attempting to access OwnCloud through an untrusted domain—try clicking "Add 'yourname.ddns.net' as a trusted domain." If this works, you can now connect to your OwnCloud server through the web, or by setting up a separate connection in your OwnCloud client to the DDNS address.

» If this doesn't work, you need to manually edit the OwnCloud config.php file [**Image I**]. If you can access it through your NAS's file manager (on QNAP drives, for example, you'll find it under Web\owncloud\config), download the config.php file to your hard drive, then create a copy of the original file called config-old.php. Edit the config.php file in your text editor by locating the "trusted domains" section, and adding the following line inside array () below the line trusting your NAS's IP address:

```
1 => 'yourname.ddns.net',
```

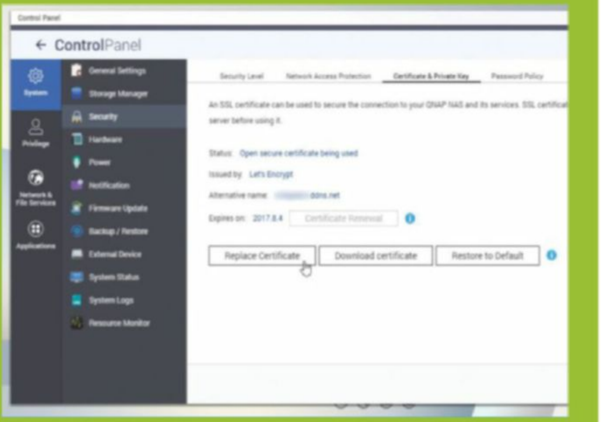
» Save the file, then upload it back to the config directory. Either reboot your NAS or stop and restart OwnCloud, then you should find you now have remote access. ⏻


I
*D:\Nick\Downloads\config.php - Notepad++
File Edit Search View Encoding Language Settings Tools Macro Run Plugins Window ?
config.php

```
<?php
$CONFIG = array (
  'instanceid' => '[illegible]',
  'passwordsalt' => '[illegible]',
  'secret' => '[illegible]',
  'trusted_domains' =>
  array (
    0 => '192.168.35.2',
    1 => 'yourname.ddns.net',
  ),
  'datadirectory' => '/share/CACHEDEV1_DATA/.qpkg/owncloud/owncloud/data',
  'overwrite.cli.url' => 'https://192.168.35.2:8081/owncloud',
  'dbtype' => 'mysql',
  'version' => '8.0.4.2',
  'dbname' => 'owncloud',
  'dbhost' => 'localhost:8081',
  'dbtableprefix' => 'oc_',
  'dbuser' => 'owncloud',
  'dbpassword' => '[illegible]',
  'installed' => true,
  'forcessl' => true,
  'mail_from_address' => 'nick',
  'mail_smtpmode' => 'php',
  'mail_domain' => 'nickpeers.com',
  'forceSSLforSubdomains' => false,
```

PHP Hypertext Preprocessor file length : 778 lines : 27 Ln : 9 Col : 30 Sel : 0 | 0 Unix (LF)

ADD SSL TO OWNCLOUD


Control Panel
ControlPanel
System
Privilege
Network & File Services
Applications
General Settings
Storage Manager
Security
Hardware
Power
Notification
Firmware Update
Backup / Restore
External Device
System Status
System Logs
Resource Monitor
Security Level
Network Access Protection
Certificate & Private Key
Password Policy
Certificate Renewal
Replace Certificate
Download certificate
Restore to Default

An SSL certificate can be used to secure the connection to your QNAP NAS and its services. SSL certificat server before using it.

Status: Open secure certificate being used

Issued by: Let's Encrypt

Alternative name: [redacted] ddns.net

Expires on: 2017.8.4

We strongly recommend you force OwnCloud to use a secure SSL-encrypted connection to improve privacy, even when transmitting over your own network. To do this, you need to add an SSL certificate to your NAS or server—a guide to doing this manually can be found at https://help.ubuntu.com/lts/serverguide/certificates-and-security.html.

Any decent NAS should offer a simpler option, though—for example, QNAP users who set up DDNS through myQNAPcloud should open the app and select the "SSL Certificate" tab. From here, you can either purchase an SSL certificate from QNAP (www.myqnapcloud.com—$45 for three years), or choose the free option from Let's Encrypt.

QNAP users using their own DDNS address should instead open the Control Panel and navigate to "Security → Certificate & Private Key," where you can create and use a free certificate from Let's Encrypt.

Once configured in your NAS, you should find OwnCloud recognizes the SSL certificate when you switch to secure connections, although the first time you connect using the desktop or mobile client, you'll see a warning appear—verify that the certificate is the one you created, check the box, and opt to trust it. Going forward, you won't be prompted about the certificate again.

Limit Your Frame Rate Without Vsync

YOU'LL NEED THIS

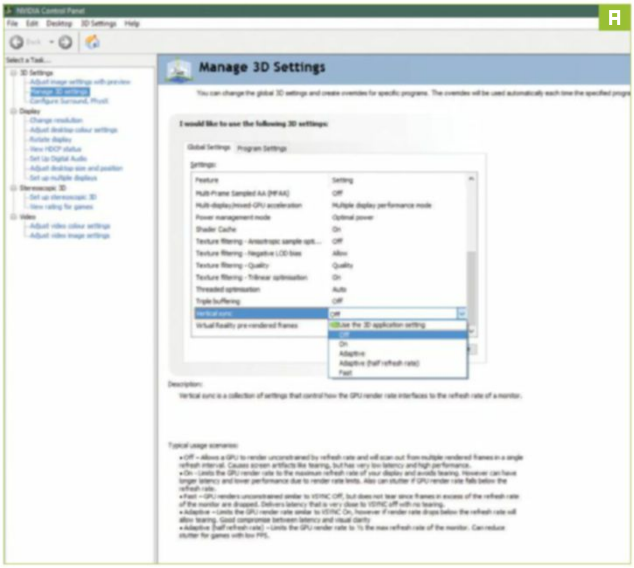
NVIDIA INSPECTOR
Tweaking suite from http://download.orbmu2k.de/download.php?id=51.

RADEON SOFTWARE
AMD's own driver/utility suite.

MSI AFTERBURNER
Download the best frame counter in the business from www.msi.com/page/afterburner.

COUNTERINTUITIVE AS IT MAY SEEM to the PC enthusiast, sometimes your frame rate is too high. It might be that your fondly remembered classic game is running like a VHS tape stuck on fast forward, because it was never designed to run on those four GTX 1080s you plumped for. It may be that you're getting a variable frame rate in a game that doesn't offer its own limiter or vsync option, and you're sick of the stutter, even above 60fps. Or, after several alarmingly high electricity bills and considerable hearing loss from listening to your red-hot GPU whine and blow a gale, you might decide that, actually, 2,500fps is more than you need in *Counter-Strike: GO*.

The reasons are multitudinous, and consequently the methods are, too. You'll want to take a different approach if you're frame-limiting an old game on an Nvidia card, for example, than if your objective is locking out a solid 60 in a DX12 title with AMD silicon in your PC. Happily, although the methods vary, they're unilaterally simple, and basically amount to finding the right option in the right screen, entering a figure, and checking a box. But, oh, the satisfaction of seeing that unwavering number in the top-left.... **–PHIL IWANIUK**



I would like to use the following 3D settings:

Global Settings | Program Settings

Feature	Setting
Multi-Frame Sampled AA (MFAA)	Off
Multi-display/mixed-GPU acceleration	Multiple display performance mode
Power management mode	Optimal power
Shader Cache	On
Texture filtering - Anisotropic sample opt...	Off
Texture filtering - Negative LOD bias	Allow
Texture filtering - Quality	Quality
Texture filtering - Trilinear optimisation	On
Threaded optimisation	Auto
Triple buffering	Off
Vertical sync	Off
Virtual Reality pre-rendered frames	

Description:
Vertical sync is a collection of settings that control how the GPU render rate interfaces to the refresh rate of a monitor.

1 CONSIDER VSYNC AS AN ALTERNATIVE

It's a good idea to take vsync completely out of the equation before heading into frame limiter territory. However, it's also a good idea to make sure vsync isn't actually the answer to your problems. If you're gaming on a 60Hz monitor, say, and you're being tormented by frame dips above 60fps, turning vsync on is the best solution, because it locks the fps output to an even division of that refresh rate. Plus, you get to eliminate screen-tearing in the process, which is a nice little kickback.

» However, when running old games, trying to even out dips below 60fps, or looking to reduce power output and temps caused by unnecessarily high frame rates, limiters are the way to go, because they cap menu screens and cinematics, too. Make your call, and proceed. There's also the world of frame limiting to improve vsync lag—we'll get to that later.

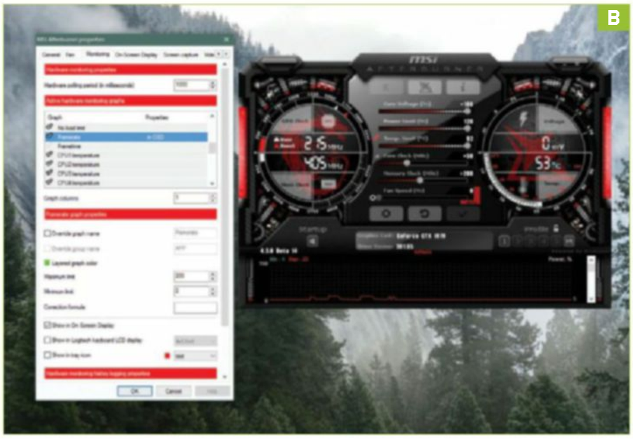
2 TURN OFF VSYNC

For Nvidia cards, head to the Nvidia Control Panel and set "Vertical sync" to "Off" in "Global settings" [**Image A**]. For AMD cards, find the "Frame rate control" header in Radeon's software, and disable '"Wait for vertical refresh." Quick and painless. You need to visit the graphics options screen of the game in question, too, and disable all vsync options there. Leaving vsync on while running a cap might tank your fps to half the desired rate, and has the potential to provide any number of complicating factors that you could do without.

3 ENABLE MSI AFTERBURNER'S FRAME COUNTER

In order to check that your limiter is working once you've set it up, you need a good, reliable counter overlay. FRAPS once ruled the roost, but doesn't play nice with DirectX 12, and common alternatives from Steam, Nvidia, and AMD can be a little limiting. For that reason, we pick MSI Afterburner.

» Don't worry, it works fine on non-MSI cards of both denominations, but it does take a bit more setting up than usual. Hit the cog button on Afterburner's main overlay, and you'll find an options screen, with several tabs at the top. Navigate to "Monitoring," check the "Frame rate" option, then the "Show in on-screen display" option below that [**Image B**]. Do the same for GPU temperature and fan speed, so you can see the benefits of your limiter. In the



next tab along, "On-screen display," choose a shortcut key to toggle the overlay on and off.

4 SET A LIMITER

So, your love for *Interstate '76* is undying, but trying to play it with a frame rate well into the hundreds results in unmanageable handling. We've all been there. Setting a limiter solves your problems, and brings the game back down to a playable speed, but it's not always plain sailing. For example, if the game in question is so old that it's using a software renderer, or you're emulating a 3dfx card to run it in the first place, setting a limiter in many programs doesn't work, because the game isn't trying to communicate with your graphics drivers directly, in the same way as a modern game does.

» For newer games, it's less of a dark art, but in both cases, we've found Nvidia Inspector to be the best program for—you guessed it—Nvidia cards. Locate the spanner and screwdriver symbol in the program's UI, and you'll open a huge options screen. Simply find "Frame rate limiter" under the "Sync and refresh" header, and select your target fps [**Image C**].

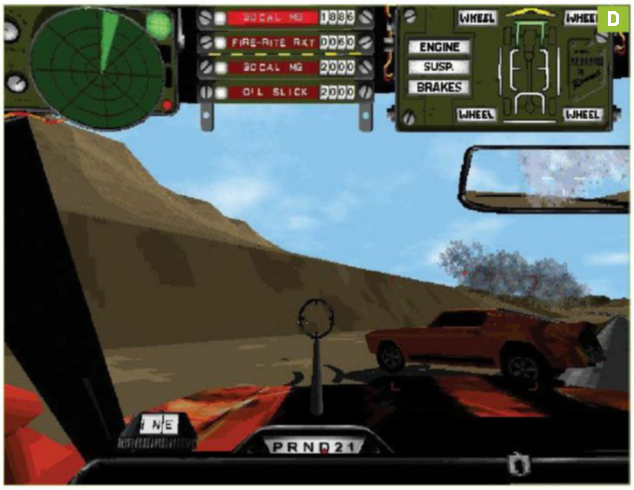
» The good news for AMD gamers is that Radeon's Frame Rate Target Control utility, bundled into Radeon Software, is actually pretty effective. Under "Game settings," find or add the game you want to cap, and scroll the bar along to the desired frame rate. And if that doesn't work, we found RivaTuner Statistics Server to be a decent contingency plan for AMD cards, too.

5 REDUCE VSYNC LAG

Vsync has a lot to do in a very short space of time. In the process of arranging your GPU's frames and serving them at just the right time for your monitor's refresh rate, a bit of input lag can creep in. However, introducing a limiter can reduce that lag. Using the methods described in the previous step, you can set a limiter of 58fps to achieve a smoother experience on a 60Hz monitor with vsync enabled, 73fps for a 75Hz display, and so on.

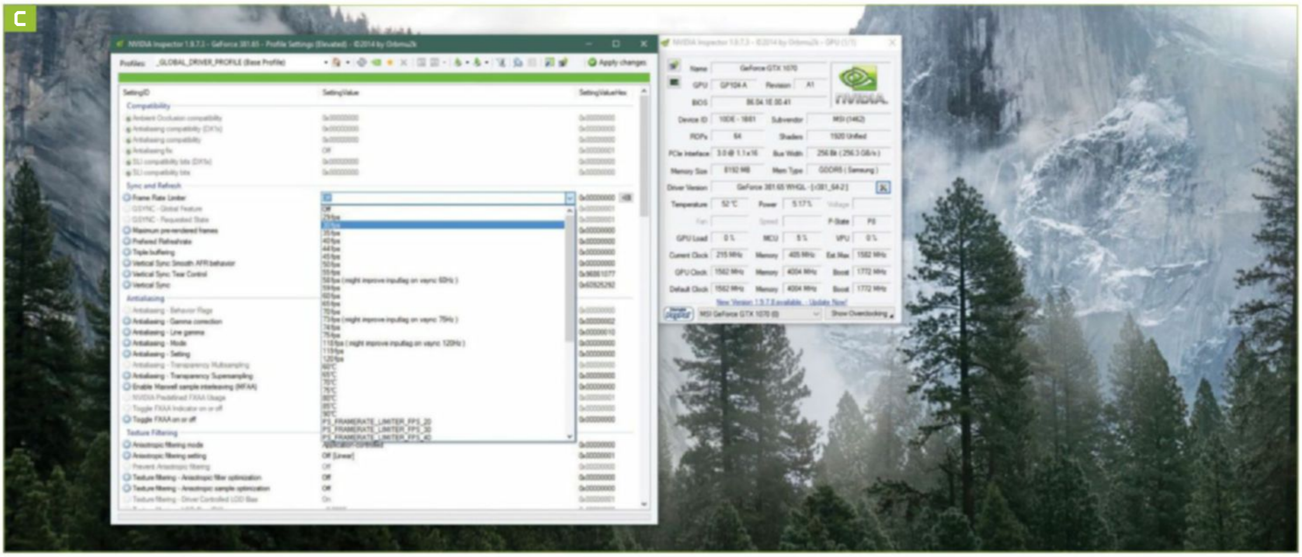
6 TEST THE RESULTS

This is where the GPU temp and fan speed readouts in the Afterburner overlay come in handy. Load up the game you want to limit [**Image D**], hit that shortcut key, and observe the overlay. You should see a lovely consistent frame rate, and reduced load on your card. Measuring vsync lag is a less exact science, but hopefully you'll feel a difference at 58fps. ⏻



LIMITING INTEL ONBOARD GRAPHICS

No, we're not joking. Having too many frames per second is admittedly extremely rare when you're relying on an integrated graphics solution to do all the heavy lifting in your games, but there are cases when setting a limiter makes sense. Laptop battery life can be extended massively, for example, by capping the frame rate. If you're getting performance in the mid-40s anyway, a 30fps cap doesn't adversely affect your experience, but does gain you lots more unplugged time. The bad news: It's harder to find a program to limit frames on Intel graphics. Turning vsync on in the Graphics Control Panel is the simplest solution, but for more control, your unlikely salvation comes from Bandicam's screen capture software. Most capture apps have a frame cap while recording, but Bandicam enables you to set a cap regardless of whether the red light's on. Don't worry—there's no performance hit from running it in the background.



Set Up Your Own Raspberry Pi Wiki

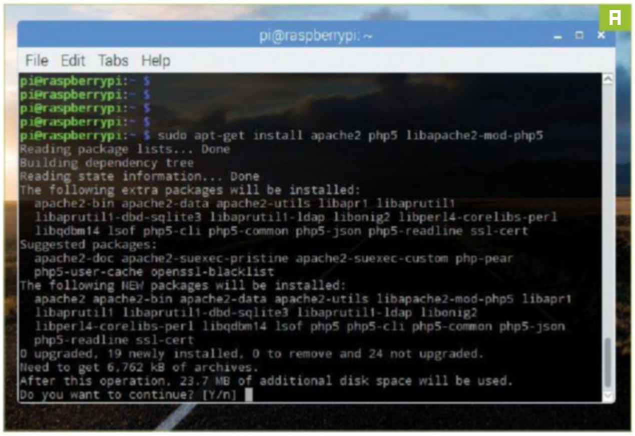
YOU'LL NEED THIS

A RASPBERRY PI
Any model of Pi should work, from the first edition up.

RASPBIAN
Find everything you need at www.raspberrypi.org/downloads/raspbian/.

THE RASPBERRY PI IS PERFECT for a vast number of single-serving uses, and it's cheap enough and light enough on power usage that you can reasonably keep one running at all times. What we're doing here is more of a secondary purpose; it doesn't matter what you've got your Pi doing day-to-day, because having it host a web page or two, or serve as a base for your HTML experiments, barely taxes the little board at all.

Our aim is actually twofold: to install a LAMP bundle—Linux, Apache, MySQL, PHP—to give us everything we need to run and serve web applications, and then to install some useful web software on top of it, to really take advantage of our intranet. What better practical application for what is essentially your own home intranet than a personal wiki? It's the perfect place to make notes about your personal affairs, keep grocery lists, and share important information with your whole family. We'll install the big boy of the wiki world in the form of MediaWiki, the software that powers Wikipedia—but keep this inside your local network, and be cagey about precisely what you host, because we're not exactly locking this data away. –**ALEX COX**



```
pi@raspberrypi:~ $
pi@raspberrypi:~ $
pi@raspberrypi:~ $
pi@raspberrypi:~ $
pi@raspberrypi:~ $ sudo apt-get install apache2 php5 libapache2-mod-php5
Reading package lists... Done
Building dependency tree
Reading state information... Done
The following extra packages will be installed:
  apache2-bin apache2-data apache2-utils libapr1 libaprutil1
  libaprutil1-dbd-sqlite3 libaprutil1-ldap libonig2 libperl4-corelibs-perl
  libqdbm14 lsof php5-cli php5-common php5-json php5-readline ssl-cert
Suggested packages:
  apache2-doc apache2-suexec-pristine apache2-suexec-custom php-pear
  php5-user-cache openssl-blacklist
The following NEW packages will be installed:
  apache2 apache2-bin apache2-data apache2-utils libapache2-mod-php5 libapr1
  libaprutil1 libaprutil1-dbd-sqlite3 libaprutil1-ldap libonig2
  libperl4-corelibs-perl libqdbm14 lsof php5 php5-cli php5-common php5-json
  php5-readline ssl-cert
0 upgraded, 19 newly installed, 0 to remove and 24 not upgraded.
Need to get 6,762 kB of archives.
After this operation, 23.7 MB of additional disk space will be used.
Do you want to continue? [Y/n]
```

1 PREREQUISITES

We're going to assume you have a few things in place first of all. You need a working installation of Raspbian Jessie, which you can download from www.raspberrypi.org/downloads/raspbian and write to an SD card, and your Pi needs to be connected to a network. It's also handy to be able to access it headlessly—run `sudo raspi-config` from the Pi command line, switch on the SSH server, and reboot to be able to access your Pi terminal from a Windows application such as PuTTY (www.putty.org). Finally, you need to find the IP address of your Pi in order to connect to it, by looking it up on your router, or by typing `ifconfig` into the terminal.

2 UPDATE AND INSTALL

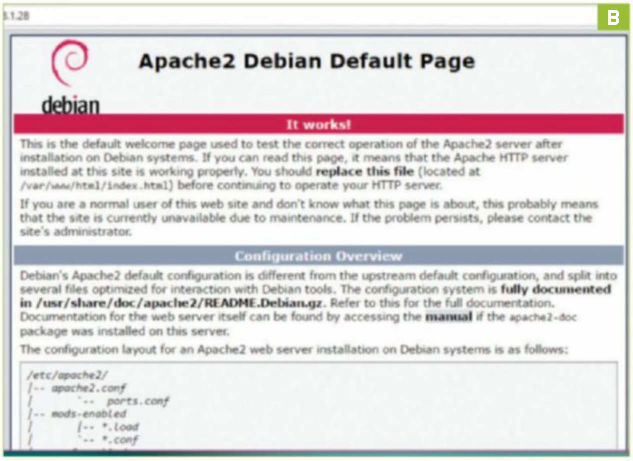
In the Linux shell, run `sudo apt-get update` to make sure your Pi is looking for the very latest software packages, then `sudo apt-get upgrade` to pull everything on your system up to the most recent version. Now we can use "apt-get" to pull in a bunch of packages at once: Type `sudo apt-get install apache2 php5 libapache2-mod-php5` to download and install the A and P portions of the LAMP equation, along with a bunch of packages on which they depend [Image A]. All being well, that's everything you need to do to start hosting HTTP content—you can now head to a web browser on any machine in your network, and type your Pi's IP address into the address bar to see the default Apache landing page [Image B].

3 CREATE A DATABASE

You can now start hosting flat HTML pages to your local network by placing them in the "/var/www/html/" directory on your Pi. But that's a bit boring. To take things further, and install some serious web applications, you need a database running, and MySQL is the most straightforward choice. Run `sudo apt-get install mysql-server mysql-client php5-mysql` in a terminal to get the necessary components, then set a password for your all-powerful MySQL root user when prompted [Image C]. Make sure it's secure and memorable, as ever.

4 DOWNLOAD MEDIAWIKI

Nearly done with installations now—run `sudo apt-get install mediawiki imagemagick php-apc` to get the final few components we need, including MediaWiki. Type `sudo nano /etc/mediawiki/apache.conf` to open a MediaWiki configuration file, then remove the # from the third line down. Hit Ctrl-X, then Y to save changes, then run `sudo nano /etc/apache2/apache2.conf` to open the Apache configuration file, and add the line `Include /etc/mediawiki/apache.conf` to the bottom, before exiting and saving as before. Reboot with `sudo reboot`.



Apache2 Debian Default Page

It works!

This is the default welcome page used to test the correct operation of the Apache2 server after installation on Debian systems. If you can read this page, it means that the Apache HTTP server installed at this site is working properly. You should **replace this file** (located at /var/www/html/index.html) before continuing to operate your HTTP server.

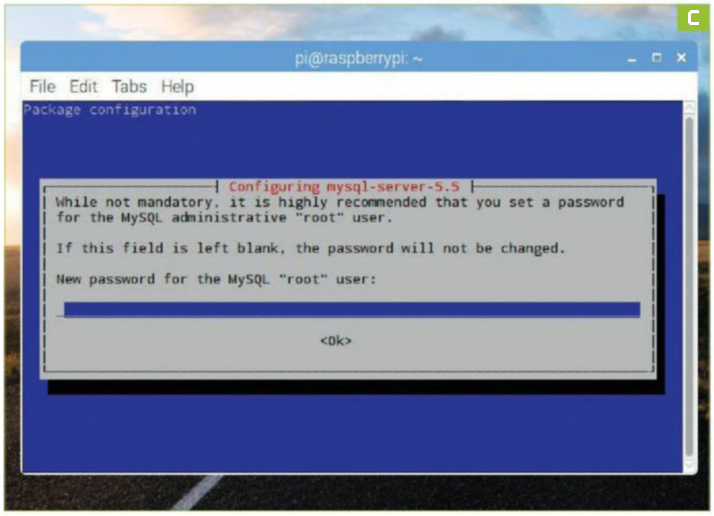
If you are a normal user of this web site and don't know what this page is about, this probably means that the site is currently unavailable due to maintenance. If the problem persists, please contact the site's administrator.

Configuration Overview

Debian's Apache2 default configuration is different from the upstream default configuration, and split into several files optimized for interaction with Debian tools. The configuration system is **fully documented in /usr/share/doc/apache2/README.Debian.gz**. Refer to this for the full documentation. Documentation for the web server itself can be found by accessing the **manual** if the apache2-doc package was installed on this server.

The configuration layout for an Apache2 web server installation on Debian systems is as follows:

```
/etc/apache2/
|-- apache2.conf
|       `--  ports.conf
|-- mods-enabled
|       |-- *.load
|       `-- *.conf
```



```
Package configuration

┤ Configuring mysql-server-5.5 ├
While not mandatory, it is highly recommended that you set a password
for the MySQL administrative "root" user.

If this field is left blank, the password will not be changed.

New password for the MySQL "root" user:

<Ok>
```

5 SET UP THE WIKI

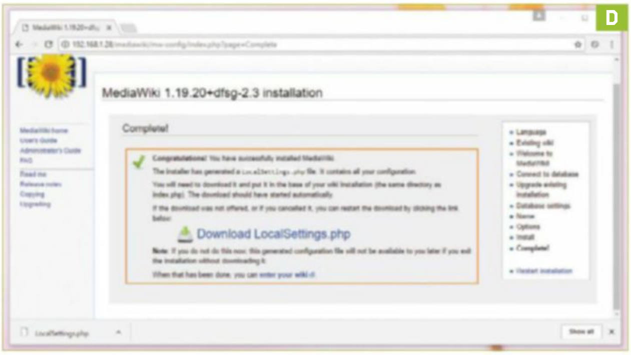
Head over to your web browser, and type your Raspberry Pi's IP address followed by "/mediawiki"—if you see the sunflower graphic, everything's going well. Click "Set up the wiki," set your language, and MediaWiki pokes at your Raspbian installation to make sure it has everything it needs to run. If you get the green light (and, at this stage, there's no reason you shouldn't), scroll down, and click "Continue." The only thing you need to enter on the next page is the MySQL password you set earlier—leave everything else as it is, and skip the subsequent page altogether. Give your wiki a name, assign a username and password to the wiki's administrator—that would be you—and click the radio button that suggests you've had just about enough of all this, then click "Continue" a couple of times to finish the installation. There's going to be a few minutes here when MediaWiki seems to have hung, but give it a little time.

6 PLACE THE CONFIG

Now, as though that installation was far too easy, you're given a configuration file [**Image D**], which you need to place in the "/var/lib/mediawiki/" folder. If you're doing the configuration on the Pi desktop, just open a terminal, and type `sudo mv Downloads/LocalSettings.php /var/lib/mediawiki/`. Or, if you're accessing your Pi remotely, use an FTP package, such as Filezilla (http://filezilla-project.org), to drop the downloaded file in the same directory, overwriting the one that's there [**Image E**].

7 CHECK IT OUT

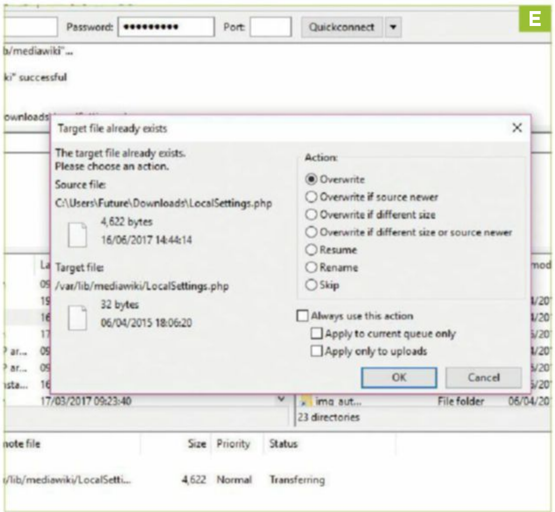
With that done, your wiki is ready to go: Just point a browser on your network to "192.168.1.10/mediawiki/" for example (switching that IP address for that of your Pi), and you'll see the default page. One last thing to do: enable image uploads. Jump into a terminal on your Pi, and type `sudo chmod /var/lib/mediawiki/images 755` to give proper permissions to the appropriate directory, then `sudo nano /var/lib/mediawiki/LocalSettings.php` to open the config file for editing. Find "$wgEnableUploads," and change its value from "false" to "true," then find "$wgServer," and add a hash symbol before it to comment it out. Hit Ctrl-X to save and quit, and you're finished. ⏻



MediaWiki 1.19.20+dfsg-2.3 installation

Complete!

Download LocalSettings.php



Password: ••••••••• Port:

b/mediawiki"...

ki" successful

ownloads

Target file already exists

The target file already exists.
Please choose an action.

Source file:
C:\Users\Future\Downloads\LocalSettings.php
4,622 bytes
16/06/2017 14:44:14

Target file:
/var/lib/mediawiki/LocalSettings.php
32 bytes
06/04/2015 18:06:20

Action:
● Overwrite
○ Overwrite if source newer
○ Overwrite if different size
○ Overwrite if different size or source newer
○ Resume
○ Rename
○ Skip

☐ Always use this action
☐ Apply to current queue only
☐ Apply only to uploads

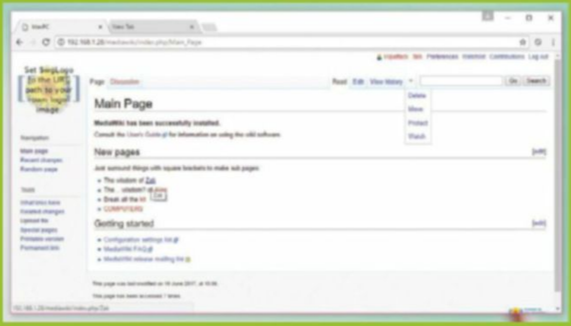
17/03/2017 09:23:40

img aut... File folder 06/04/20

23 directories

note file	Size	Priority	Status
/lib/mediawiki/LocalSetti...	4,622	Normal	Transferring

USING YOUR WIKI



Editing a wiki is simplicity itself, using a very straightforward markup language. Log in to your wiki with the credentials we set in step five, then click the "Edit" link, and type away, using the string of buttons at the top of the editing box to format text appropriately, or add links to images or files—upload these using the link in the left column. If you want to create a new wiki page, make a link to it by surrounding some text with [[double square brackets]], save your edit, and click the new red link to start editing it.

There are, of course, a bunch of slightly more complex ways to organize your pages, and the default main page includes a link to MediaWiki's own site, explaining many of these. If you want to add additional functionality beyond flat pages—a calendar, perhaps—you need to install an extension. This is usually as easy as downloading a file and adding a line to the LocalSettings.php file; check out www.mediawiki.org/wiki/Category:Extensions_by_category to see what's available.

Bend Perspective in Photoshop

YOU'LL NEED THIS

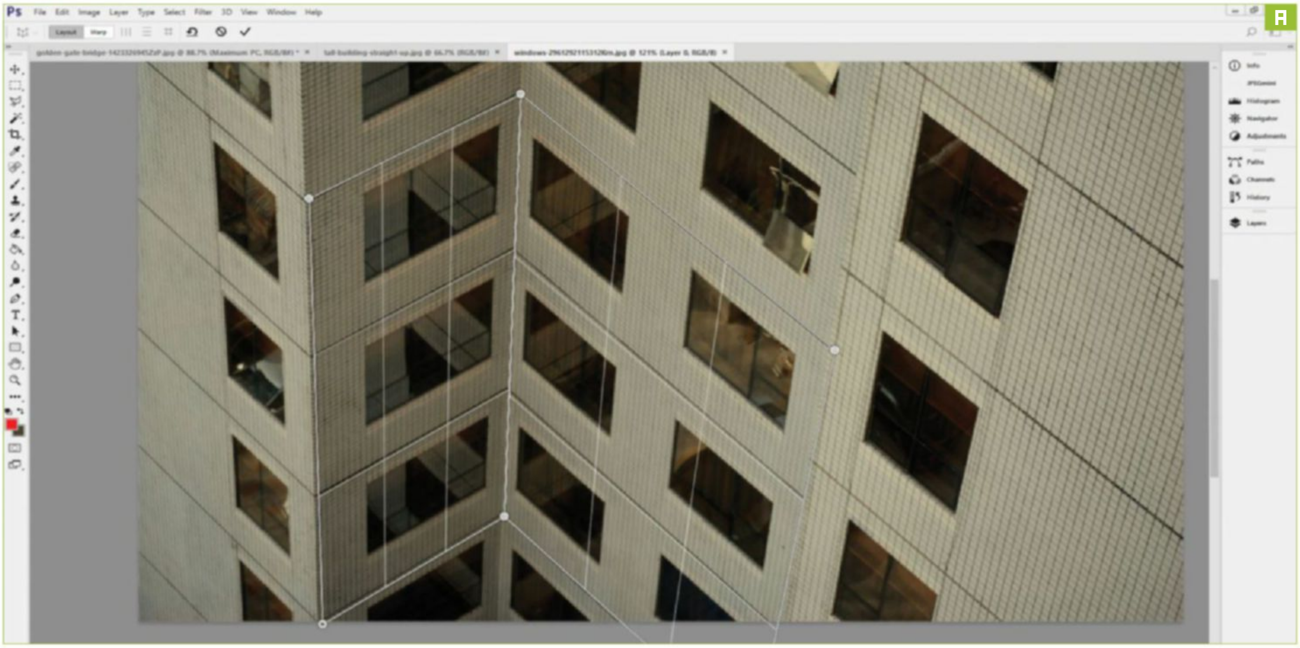
PHOTOSHOP
Subscribe to a package at www.adobe.com/photoshop.

PERSPECTIVE WARP was one of the new features in Photoshop CC that passed many people by. It seems complicated, brings back memories of the terrifying 3D interface, and requires a bit of preparation work before you see results.

In reality, it's a much easier process than using Photoshop's 3D tools, and as long as you follow the setup procedure, it's quite simple to get something that looks good.

Perspective is the relationship between objects in an image, and can usually only be changed by moving the camera and taking another picture. Even changing the lens you're using doesn't affect it, although focal length may alter the perceived distance between objects as they recede into the background, with a telephoto lens causing them to appear bunched up.

Perspective Warp enables you to alter the look of a 2D object, so it matches the background you're compositing it on to, or mark out straight lines in an image, so that they don't change when you warp the rest of the photo. –**IAN EVENDEN**



1 ENABLE GPU PROCESSING

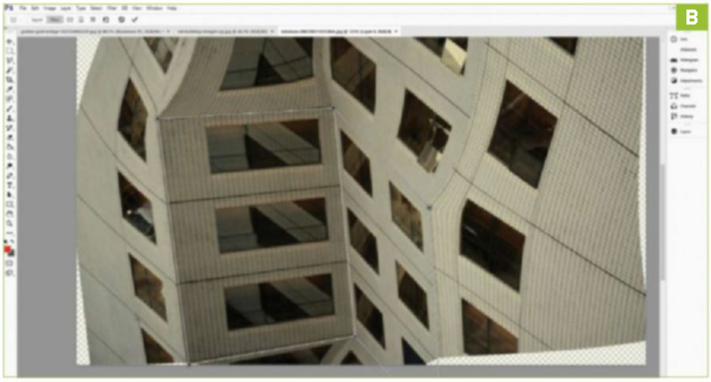
Perspective Warp needs to use your GPU. You don't need a FireGL or Quadro—anything from Intel HD upward should do the trick—but it's worth checking if you've got it enabled, otherwise the Oil Paint filter won't work either. Head to "Edit → Preferences → Performance," and check "Use graphics processor" in "Graphics processor settings," and "Use graphics processor to accelerate computation" in "Advanced settings."

2 DEFINE PLANES

To warp something like the corner of a building, you first need to define the planes. These are flat areas of the shape, and you can intersect planes to create corners. With your image open and background layer selected, head to the "Edit" menu, and select "Perspective Warp." Photoshop provides some handy hints to take some of the mystery out of what you're doing, and they do a good job of explaining it. You need to draw rectangles over the flat planes of the object in your image—so with the corners of a building, that means each side gets its own rectangle [**Image A**]. This is Layout mode, and there's a mode selector in the top-left. Drag out a rectangle, then move its corners so they're in the corners of the plane you want to mark. You can join them together to cover corners of the building just by dragging their corners so they touch.

3 WARP!

Once you're done defining, you can get on with the warping. There are a couple of automatic options, or you can use the mouse. Change to Warp mode, and the rectangles you placed in Layout mode lose their grid lines, but otherwise stay where you put them. What's new is that moving their corners now affects the image, rather than just changing the rectangles. The automatic options—buttons to the right of the mode selector—are to straighten



near vertical lines, straighten near horizontal lines, and straighten both. If you've fallen prey to the phenomenon of converging verticals by taking a photo of a tall building with a camera that's tilted back from vertical, this can help you out. It can even turn an image of a building's corner into one in which both sides of the edifice appear as one continuous wall—although it can do strange things to any roads or trees also in the image if you do this. At any time, you can use the mouse to drag one of the corners—Photoshop now calls them "pins"—across the image for an even stronger effect [**Image B**].

4 TRY OUT SOME TEXT

If you've played *Prey,* you'll have seen the text of the intro incorporated into the city when you take the helicopter ride right at the beginning. Being an entirely rendered experience, this wasn't done in Photoshop, but you can achieve a similar effect. A text layer must be rasterized before you can warp it, but the app reminds you of this. Use the Text tool to add your text to an image, and make sure you've got the text layer selected before you select "Perspective Warp." It's also a good idea to move it roughly into the area you want it to end up, because trying to move it when in Warp mode sometimes fails. Rasterize as needed, then drag your rectangle in the Layout stage. When you begin to warp, concentrate on getting the perspective right, rather than anything else, as once you're finished, the text can be moved or rotated again.

WHAT ELSE?

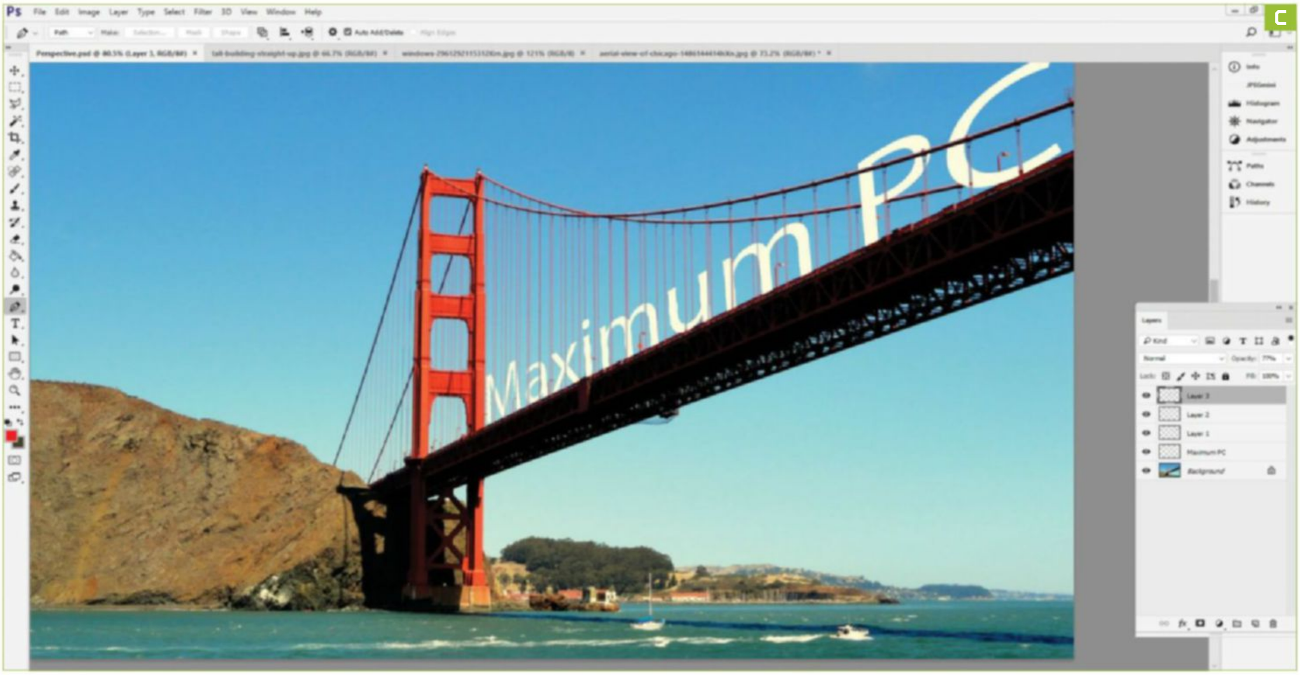
As we rasterized the text layer before we warped it, the implication is you can use this technique on any raster layer—and that's true. Say you want to composite a car on to a street scene, but the two were photographed at slightly different angles. Twist the car using Perspective Warp, and make it look as if it's at a sharper angle to the camera. The changes are small, however, so for the best results, you might end up doing one shoot again, and getting the setup right. But for a slight shift, it's more than good enough, as long as no one looks too closely!

5 SHADOW PLAY

If your text is in the right sort of place within the image, you can make it stand out by adding a shadow. Add another text layer that says the same thing as the first, color it gray, and use Perspective Warp to bend it into a shadow for the first layer, to make the text appear as though it's standing up within the landscape of the image—for example, if you've placed it on a lawn or a beach. Take note of the direction of other shadows in the image, because it won't look right if your new shadow is pointing in a different direction. Once you're done shifting the perspective, use a blend mode, such as Multiply, to make the shadow melt into the underlying image.

6 SETTLE IN

To really settle your text into the image, hide the layer it's on, and decide whether any parts of the underlying image should be in front of the text. Select them, feather the selection by a few pixels ("Select → Modify → Feather") to soften the join, and use "Layer → New → Layer via copy" to copy them to a new layer. Move this layer to the front of the stack in the Layers palette, re-show the text, and it should now be part of the image, as though it was always there [**Image C**].



Pi Camera: Take Timelapse Photos

YOU'LL NEED THIS

ANY RASPBERRY PI WITH A 40-PIN GPIO CONNECTOR

Raspbian Pixel, official Pi camera, 1x push button, 1x breadboard, 1x MCP3008 ADC, 9x male-to-male jumper wires, 8x female-to-male jumper wires, 2x 10k potentiometers

TIMELAPSE PHOTOGRAPHY can create fascinating footage of certain phenomena, such as plants growing and flowering, that you wouldn't get to see in such detail in everyday life. Using the Raspberry Pi camera for timelapse is a simple project, but ensuring that the subject of your photography is lit correctly can be a little tricky. In this project, we shall create a timelapse controller that has analog controllers for the brightness and contrast of the images to be captured. The files saved will also have a timestamp, to ensure that they're captured correctly and can be reviewed in chronological order. –**LES POUNDER**

1 CIRCUIT CITY

To build the circuit for this project, we need to place an MCP3008 analog-to-digital converter on to the breadboard. Pay special attention to a dip in one end of the chip, which identifies the top of the chip. Pin 1, which is the first analog input, is located in the top-left of the chip if we look at the chip with the dip at the top.

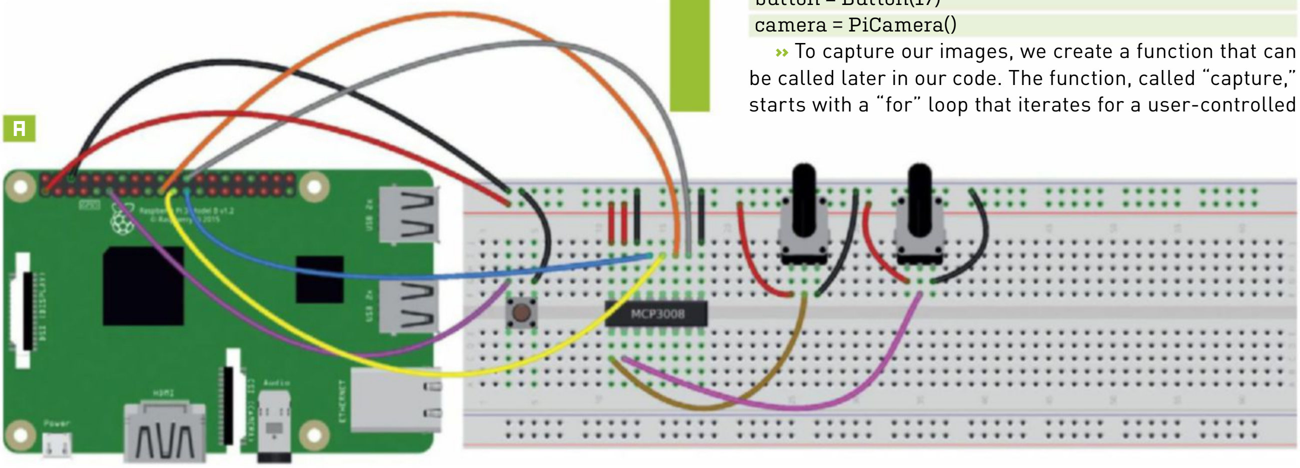
›› Connect the MCP3008 to your Raspberry Pi as per the diagram shown below [**Image A**]. The potentiometers are connected to 3V and GND rails, and their output is fed into the first two pins of the MCP3008. Our push button is connected to the GPIO and to the GND rail.

›› Next, insert the official Raspberry Pi camera into the camera port [**Image B**], which is located either between the Ethernet and HDMI port of the model B series, or on the end of the Pi Zero board—note that this requires a special adapter. The ribbon cable should be carefully inserted with the blue tab that's facing the Ethernet port, and remember to lift the plastic guard on the port before inserting, then close the guard to lock the camera in place. Applying a small blob of modeling clay prevents the camera from making contact with the GPIO pins, which could damage the camera. Now connect your keyboard, mouse, and so on, and power up your Raspberry Pi to the desktop.

2 GETTING STARTED

The official Raspberry Pi camera and our MCP3008 both need their interfaces configuring. To do this, go to the Raspberry Pi Configuration tool, which is located in the "Preferences" menu. In the "Interfaces" tab, enable the Camera and SPI interface. Save your configuration, and the application now asks you to reboot. Do so, and return to the Raspbian desktop.

A



›› To test the camera, open the Terminal, and enter this command to take a photo, which will be output as image.jpg:

```
$ raspistill -o image.jpg
```

›› If this doesn't work, repeat the configuration, power down the Pi, and check that your cable is inserted correctly.

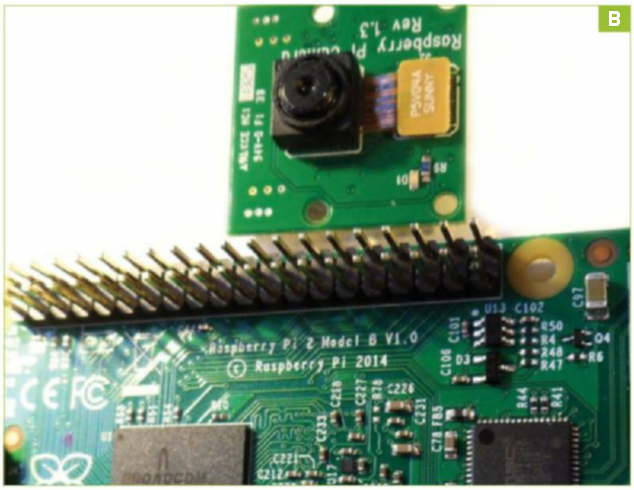
›› Now to write some code. Go to the "Programming" menu and click "Python 3." When the application opens, click "File → New" to create a new blank file. Immediately save the file ("File → Save") as timelapse-controller.py before carrying on. We start the code by importing the libraries that we will be using. These are "picamera," used to control the camera; "GPIO Zero" for our analog-to-digital converter and the push button; the "sleep" function is imported from the "time" library; and we'll need "datetime" to create a timestamp later.

```
from picamera import PiCamera
from gpiozero import MCP3008, Button
from time import sleep
from datetime import datetime
```

›› Now we need to set up the channel connections to the MCP3008, tell the GPIO where our push button is connected, and create an object from the "picamera" library that makes it easier to work with:

```
pot1 = MCP3008(channel=0)
pot2 = MCP3008(channel=1)
button = Button(17)
camera = PiCamera()
```

›› To capture our images, we create a function that can be called later in our code. The function, called "capture," starts with a "for" loop that iterates for a user-controlled



number of times. The "for" loop creates a timestamp—the time and date at that moment—then uses that value as a filename to capture an image. The loop then sleeps for another user-controlled duration before repeating:

```
def capture():
  for i in range(timer):
    timestamp = datetime.now().isoformat()
    camera.capture('/home/pi/%s.jpg' % timestamp)
    sleep(delay)
```

›› In order to see what the camera sees, we create a preview window. In this case, this window has a fixed resolution of 640x480, and is placed in the top-left of the screen (0,0). But, typically, the preview is full-screen.

```
camera.start_preview(fullscreen=False, window = (0, 0, 640,
480))
```

3 TRY AND TRY AGAIN

Using a "try, except, finally" construction to handle any errors and the user exiting the code, we create two variables: "timer" and "delay." The "timer" variable stores the amount of time in minutes that the timelapse should run for. The "delay" variable is used to store the delay in seconds between shots. Both variables capture user input from the keyboard, and convert it to an integer:

```
try:
  timer = int(input("How long in minutes should the timelapse
run for?"))
  delay = int(input("How long is the delay, in seconds, between
shots?"))
```

›› Inside a "while True" loop, we now take the value of the potentiometer, typically between 0.0 and 1.0, and multiply it by 100 to give us a value to control the brightness and contrast of the image. Turning the potentiometers changes the value, and prints the new value to the shell:

```
  while True:
    brightness = round(pot1.value * 100)
    print("Brightness",brightness)
    contrast = round(pot2.value * 100)
    print("Contrast",contrast)
```

›› Use the "brightness" and "contrast" variables to update the preview window, showing the change in configuration. We then create the "settings" variable that contains both values:

```
    camera.brightness = brightness
    camera.contrast = contrast
    settings = "Brightness: "+str(brightness)+"
 Contrast: "+str(contrast)
```

›› These settings are then printed to the Python shell, before being annotated to the preview window, typically at the top-center of the image. There's a sleep step of 0.1 seconds before the process is repeated:

```
    print(settings)
    camera.annotate_text = settings
    sleep(0.1)
```

›› Now our button is ready to start the timelapse sequence. When the button is held for two seconds, it calls the "capture" function (created earlier). This then captures a timelapse using the "timer" and "delay" variables that the user specifies.

```
    button.when_held = capture
```

›› We now come to the final part of the project. Here we have the "except" part of the construction. This handles the user exiting the application by pressing Ctrl-C, a keyboard interrupt. It stops the preview, then moves on to the "finally" part, where we print that the application has exited to the Python shell:

```
except KeyboardInterrupt:
  camera.stop_preview()
finally:
  print("TIMELAPSE EXITING")
```

›› Save the code, then click "Run → Run Module" to start. The preview window opens, and you can tweak the brightness and contrast using the potentiometers, set the timer and delay, then, when ready, press and hold the button to start the sequence. Now all you need to do is find a suitable subject to photograph over time. ⏻

DIGITAL FLICK BOOK

We recently had to create a timelapse video using images, and the first obstacle we faced was converting the timestamps into an ascending numerical order of images. Luckily, and thanks to a little Bash magic, we found a one-line shell script that managed to convert the timestamp images into numbers. We did this with a copy of all the images, to ensure that we had backups.

```
$ ls | cat -n | while read n f; do mv "$f"
"$n.jpg"; done
```

So, why did we capture the images with a timestamp? Well, this project can be used in scientific experiments, so capturing the time and date of each image means that we can review when a change took place, say watching cress or sunflowers grow.

To create the video we used avconv. This can be used with the Raspberry Pi. To install it, open the Terminal and type:

```
$ sudo apt-get install libav-tools
```

We used it with a Core i5 laptop, because it's much quicker in terms of performance. Now run the command in the same directory as the images we've just renamed. This will set the frame rate to 10fps, it will start from number 1 in the sequence of images, it sets the bitrate to 1,000k, and saves the file to test.mp4:

```
avconv -r 10 -start_number 1 -i %d.jpg
-b:v 1000k test.mp4
```

Now open the video using omxplayer, and enjoy the fruits of your labor.

```
omxplayer test.mp4
```

BUILD IT

ZAK STOREY, REVIEWS EDITOR

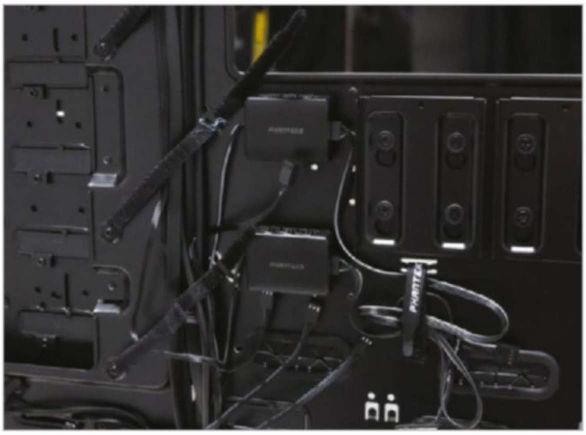
Dream Machine 2017

An insight into the many troubles that we encountered when putting together this year's truly titanic Dream Machine

LENGTH OF TIME: **36-48 HOURS** | LEVEL OF DIFFICULTY: **EXTREME**

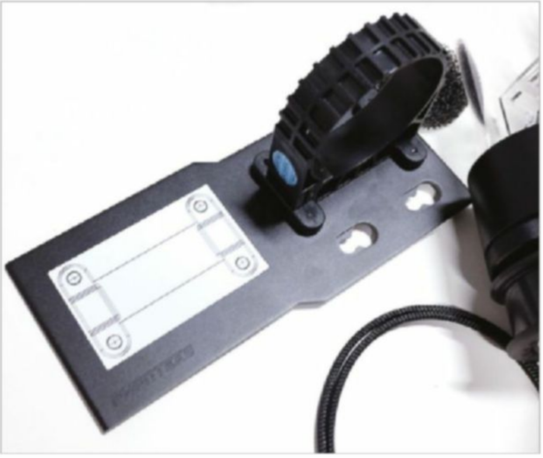
1 CABLES GALORE

BOY, IS THIS CASE A MONSTER! The Enthoo Elite can house two systems internally—a full sized XL-ATX and an ITX below—if you fancy it. And because of that, there are two sets of front I/O, meaning excess cables everywhere. On top of that, due to the phenomenal size of the case, Phanteks has included two of its own PWM fan headers, and a whole plethora of Velcro cable ties, including spares, to help cable-manage your system. The first thing we did here was strip out those two pump mounts seen below, and remove the left cable cover panel, so we could drill into it and the aluminum covers, to mount our two reservoirs. Speaking of which....



2 MARKING UP MOUNTING

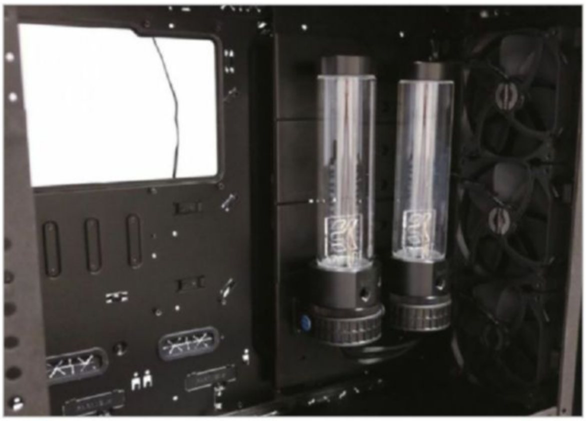
MOUNTING THE RESERVOIR BRACKETS on the SSD brackets at first seemed like quite a challenge—at least, until we delved into the box and found that EK includes these awesome bracket mounting stickers with its Revo D5 pump models. Simply line up your stickers, make sure there's enough space between the two reservoirs, then you can go off and drill through the four mounting points with the appropriate drill bit. Drilling through this aluminum plate was a dream; it's one of the few materials that feels both solid and soft when you're drilling through it.



3

RESERVOIR REQUIREMENTS

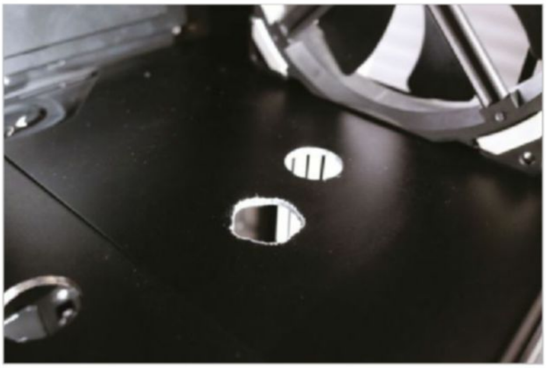
THEN CAME THE TRICKY PART. Once the holes were drilled through the aluminum bracket, we had to remove the sliding cable cover panel behind it to drill through that as well. Fortunately, it's secured in place with simple Phillips head screws, so it's simply a case of removing the necessary screws, taking the panel out, removing the plastic cable covers and any of the rubber mounting grommets for those aluminum panels, marking up where the holes need to be drilled, and going at it again. It's worth noting that this steel panel was far more difficult to drill through than its aluminum counterpart, despite being about a third as thick.



4

THE RIGHT BIT

ONCE WE HAD OUR RESERVOIRS FITTED, our next job was to mark up our pass-throughs. For this, we cut a few pieces of tube to length, installed the fittings on the res, and marked with a metal punch where we wanted to drill through the panel, using the tubing as guides. Both of these PSU compartment covers are removable sheets of 4mm aluminum, so we can remove them from the case, clamp them down, and drill through. The diameter of the hole necessary for the pass-through is 20mm. We ended up needing to use a spiral flute step drill bit to get through the panel, after attempting to use a traditional drill bit. The one on the left still works effectively, but the one on the right is clearly far cleaner, thanks to using the correct tool.



5

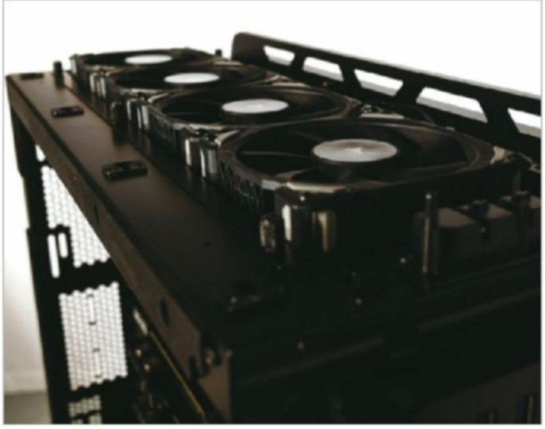
RADIATOR RIOTS

THANKS TO PHANTEKS'S intuitive case design, these radiator brackets make installing the meaty 480mm radiators as easy as pie. Simply remove the bracket from the case by taking out the six attached thumb screws, then place it on top of your radiator, and mount your fans to your radiator, sandwiching the radiator bracket in the middle. We had to do this twice, though, because on our first attempt we managed to misalign the radiator a fraction, stopping us from securing the bracket in place. This meant we had to remove each individual Allen-headed screw (all 16 of them), shuffle the fans and radiator along, resecure them, then reattach it all to the top of the case.

6

FAN CABLING

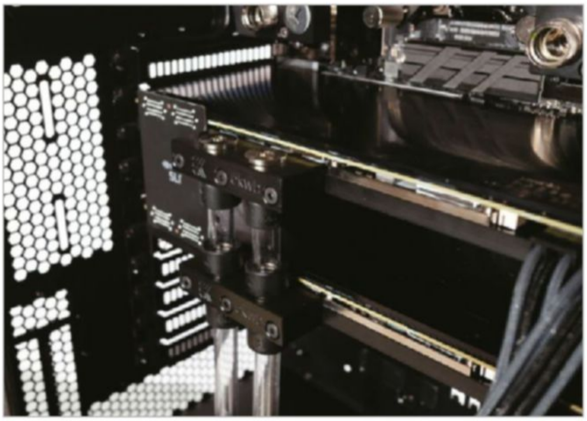
HERE'S A SHOT OF THAT TOP RADIATOR mounted in place, with the four Corsair ML120 Pros securing it. It seems like a moot point, but on a chassis as big as this, correct fan orientation is imperative. We're not talking about push versus pull here, but rather cable orientation. Find your cable routing holes, and orient your fans so the cables can reach those holes with ease. With the Elite being such a stupendously tall case, even with the two PWM fan headers, it's imperative you get this right, because the fewer cables you have in the back, the better, and using fan splitters or headers is less than desirable.



7

NIGHTMARISH GPU TUBING

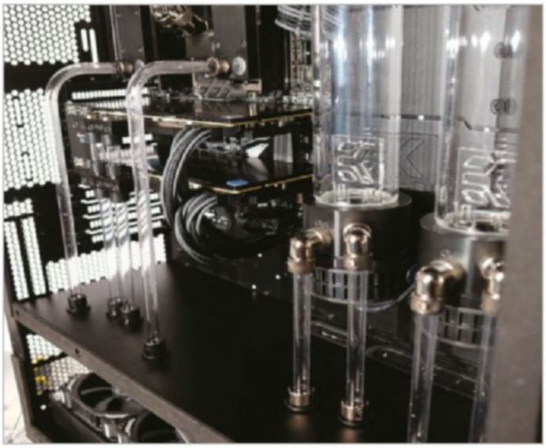
IT'S FUNNY, but those two tiny pieces of tubing are some of the most difficult parts to create. It took around six attempts to get them the right length. Too long, and they'll place too much pressure on the PCIe slots, and stop you from using a fixed HB bridge. Too short, and you run the risk of a leak. EK can sell you an FC Terminal dual-slot adapter, but you have to know ahead of time which slots you're using, and it's another $40 on top. To connect these two pieces of PETG, we took both the cards out of the motherboard, installed the two tubes, then carefully placed them back into the motherboard, before fitting the HB bridge again. It took some wiggling, but it looks a treat.



8

DUAL LOOPS AND MEMORY COOLING

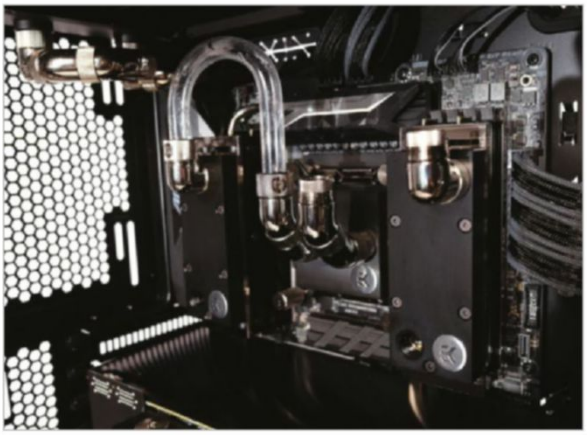
MEMORY COOLING might seem a little excessive, and some would say it's a lot of hassle and risk for little gain, but there's no arguing about how good it looks. We knew from the get-go that we wanted to run two loops, like last year, so next we had to figure out how those loops were going to operate. We did a simple 90-degree bend on a length of tubing, then replicated that, before lining up the tubes, metal punching the floor, removing the panel (fittings, tubing, and all), and reaming through another two pass-throughs, ready for our tinkering underneath.



9

CPU CONFIGURATION

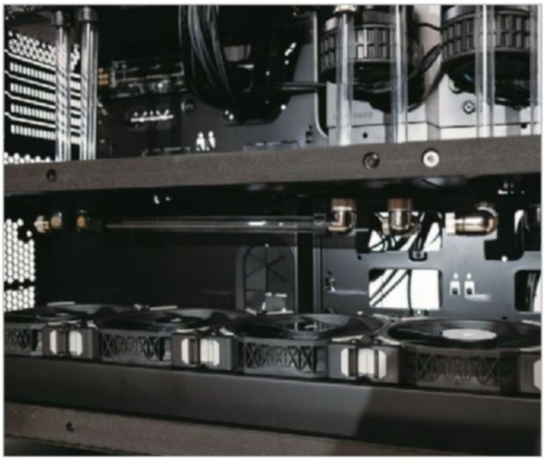
HERE'S WHAT WE MEAN by being flexible. This is our third setup of CPU tubing. First, we tried an overly complex tubing run from a single flat fitting on the CPU block to the right-angled fitting at the top of the memory block, which proved excruciatingly difficult to both bend and secure. Next, we used the same number of fittings as pictured, but with a short piece of tubing in between, which was at too tight an angle to secure. Lastly, we opted for this double U bend style, with all the fittings pointing upward. To do this, we heated up a larger area of the tubing, then slowly bent it around our deburring tool for the left side, and around an empty reservoir for the right.



10

THE UNDERCARRIAGE

HERE'S WHERE THINGS GOT REALLY TRICKY: figuring out how both loops would operate under the hood. The GPU was relatively simple—the bottom radiator connects to the pump, the pump goes to the right-hand tube of the GPU, pushes coolant into the first then the second GPU, then down, and out back to the radiator. The CPU loop, however, operates in reverse (with the coolant going in through the left), and its 480mm radiator at the top of the chassis required some inventive thinking about tubing runs to get to the right-hand reservoir, but more on that later....



11

TUBING MANAGEMENT

HERE'S WHAT WE'RE TALKING ABOUT. There are two tubing runs going from that top radiator, using two T-blocks, to the loop at the bottom of the chassis. Amazingly, the D5 pumps coolant from the pump, through the DDR4 on the left side, to the CPU, through the other set of DDR4 on the right, down, then back up to the radiator, using the right-hand side tubing run, where it cools it, goes back into the left tubing run, down, and then back to the pump. Ideally, we'd have preferred to use soft tubing here, but as it was our last day of shooting, we had no time to order some in, although it's definitely on the cards for a future upgrade. This was also prior to our cable management run, which brings new joy to putting on that side panel.

12

DREAM MACHINE 2017

THERE YOU HAVE IT: Dream Machine 2017, complete and ready to go. We went with red and white coolant: red for the CPU loop, and white for the GPUs. We mixed the white with Mayhem's Silver Aurora concentrate to try to replicate the particle effect you see in the red coolant pictured. It's great to indicate flow, and looks stunning. As for filling the loop, we disconnected all power from the motherboard and graphics cards, and used a 24-pin bridge on the ATX power. We also disconnected the pump that wasn't going to be filled (as you should never run a pump dry). Then it's simply a case of filling the res until it's about two-thirds full, and cycling the power supply to prime the loop.

THE DREAM REALIZED

DM 2017 took a lot out of our reviews editor. It was a mammoth task that took three months to plan, and over five days to build and shoot, driving everyone involved to the brink of insanity. Figuring out how the loops were going to operate, in which direction, and how the tubing runs were going to fit together was testing. Couple that with the modding of the panels to allow for the pass-throughs, the careful cable management to ensure the CPU power reached, making sure the fans fell into place, the blocks were installed correctly, and everything else was a success, and it was incredibly draining.

At *Maximum PC*, we're not afraid to admit when we make mistakes, and when it comes to the finer pursuits, such as liquid cooling and case modding—of which there was a lot this year—we still have much to learn.

Tubing runs can always be cleaner and tidier, but it was the DIY aspect of the modding that really caught us off guard—mounting the reservoirs and the pass-throughs in particular. Using the correct drill bit to get through that aluminum is imperative, as is using the right technique. We certainly could have been more precise. Working with the steel panel behind the reservoirs also proved tricky. If we did it again, we'd make sure that the pass-throughs below the GPU were better marked and separated, to make them more parallel, that the reservoir mounting in the back of the steel plate was cleaner, and that the tubing runs in the back of the chassis consisted of soft tubing, making it easier to route the tubing, tidy the cables, and be safer to transport.

That said, being flexible helped. There are 86 separate fittings in this build, in all sorts of combinations. The CPU block, for instance, uses two extension fittings at the base of the two G1/4-inch threads, followed by two 45-degree rotary fittings on each side, then a hard compression fitting on the end, to create an extended 90-degree fitting, with a bit more height to give some wiggle room with those top two tubing runs. Additionally, we used a combination of 45-degree fittings with unused pass-through fittings to connect two lengths of tube at the back of the motherboard tray, to enable us to run the loop from the uppermost radiator to the CPU pump at the bottom of the chassis.

And, of course, finding some way of mounting the hard drives in the back of the chassis (potentially on the back of the reservoir tray) would have been far nicer than our solution, which was to mount them on the included Phanteks mounting trays, on the right, slightly above the bottom radiator at the front of the case. We removed them for the photo shoot, but it's certainly possible to run them like that, forsaking a touch of airflow over that bottom rad.

Naturally, this isn't where our story ends. We'd tested the CPU, memory, hard drives, and GPUs outside the chassis, before we liquid-cooled them, but the one thing we hadn't done was test the motherboard. We just didn't have the time, as it arrived on the day of the build—so, after all the tinkering, building, and filling of the loops, on first boot we received a memory error, implying that we either needed to change the memory channels, or reseat them. Less than ideal, given what our setup entails. In short, using the two T-blocks at the top of the chassis, we attached a ball valve, drained off the CPU loop, removed the memory blocks, reseated the memory, and the problem was solved. Such are the potential setbacks of hardline liquid cooling.

That said, all in all, it's a phenomenal build. We'll let our main feature do the talking as far as performance goes (see pg. 26), but it's certainly a beauty to behold. Combine those looks with sub-50 C temperatures and minimal noise, and it's hard to argue with just how nice a system it is. The big question is, where do we go from here?

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NVIDIA TITAN XP PAGE 78

Nvidia Titan Xp

Nvidia's mighty GP102 chip fully unleashed at last

BLEEDING-EDGE GPUs have been coming thick and fast from Nvidia of late. This new Titan Xp board, for instance, finds itself among a family of at least three other seriously high performance graphics cards based on Nvidia's smash hit Pascal family of GPUs.

We've had the GeForce GTX 1080 and its GTX 1080 Ti sibling, as well as the Titan X. Admittedly, only two of those are based on the bad boy GP102 graphics chip that sits supreme in the Pascal GPU lineup. But the point is that Nvidia has been cranking out big-money boards at a frightening rate over the last year or so.

That's not going to change any time soon, what with Nvidia recently giving a sneak peak of an early board based on its upcoming Volta GPU architecture. The pace is relentless and Nvidia's rival, AMD, is struggling to keep up. But Volta and AMD's response are stories for another day. Right now, we're concerned with the ultimate manifestation of the Pascal architecture.

Titan Xp is, quite simply, the GP102 chip fully unlocked and unleashed, all 12 billion transistors of it. Count 'em. Unlike the GTX 1080 Ti and Titan X boards, Titan Xp has all 3,840 CUDA cores and 240 texture units switched on. Like the Titan X, it also has all 96 render outputs enabled, and thus the full meaty goodness of a 384-bit memory bus and 12GB of VRAM. Yum.

It also sports a Boost clock of 1,582MHz. That's identical to the 1080 Ti and a smidge quicker than the Titan X. It all adds up to 12.1 Tflops of processing power, and the title of undisputed heavyweight GPU champ. It's the most powerful gaming card ever.

If all that constitutes objective fact, how you view it subjectively is another matter. The Xp clocks in at $1,200. On the one hand, that's the same as the outgoing Titan X, meaning you get a little more for the same money. On the other, the 1080 Ti is barely over half the cost, at $699.

Thus, the additional $500 buys you about 7–10 percent more of everything: 7 percent more CUDA cores and texture units, 9 percent more render outputs, and so on, compared to the 1080 Ti. At best, you're looking at 10 percent better performance—and, most of the time, not even that. Allow us to let you in on a non-secret: That's not a big enough performance step that you will be able to feel the difference in games.

What's more, it's not as though even the Titan Xp is infallible in terms of gaming performance. There is a long list of games that it can't render smoothly at 4K with high levels of antialiasing enabled. One might argue that lots of AA at 4K is somewhat moot, and that's probably true for 4K panels from 32 inches and down in terms of size. But on a big 40-inch-plus 4K panel, you're going to want to run AA, and sometimes it will be AA of the performance-sapping MSAA variety. At that point, you're going to be pretty pissed that your $1,200 GPU can't handle the heat, and you find yourself knocking it down to 2x MSAA, or switching it off altogether to get nice frame rates.

Not that you'll do any better with some other GPU. The Titan Xp is as good as it currently gets. And a lot of the time, it's very good indeed. Paired with a sub-4K gaming panel, the result is often ridiculously smooth gaming performance. But the price creates expectations of something stellar, something completely different, an experience unlike any other. And that simply isn't the case. If you absolutely positively must have the best, this is it. But the regular 1080 Ti, if such a thing as a $699 GPU can ever be called "regular," is a far, far better buy. **–JEREMY LAIRD**

VERDICT 8

Nvidia Titan Xp

+ INTERSTELLAR The fastest graphics card in the known universe, the end.

− BLACK HOLE Will eat all of your dollars and gives relatively little in return.

$1,200, www.nvidia.com

BENCHMARKS

	Nvidia Titan Xp	Nvidia GeForce GTX 1080 Ti	Nvidia GeForce GTX 1080 Fe
Total War: Attila (fps)	**16/29**	14/27	9/19
Far Cry Primal (fps)	**54/61**	51/56	38/42
The Division (fps)	**35/62**	34/55	19/41
Rise of the Tomb Raider (fps)	**12/32**	11/29	8/20
3DMark Fire Strike (Index)	**7,166**	6,587	4,934
3DMark Time Spy DX12 (Index)	**9,097**	8,307	6,537

Best scores are in bold. Our test bed consists of an Intel Core i7-7700K, 16GB of Corsair DDR4 @ 2400, an Asus Maximus IX Hero, and a 500GB Samsung 850 Evo SSD. All games are tested at their highest graphical profile, with AA turned up, at 4K.

SPECIFICATIONS

GPU	GP102
Lithography	16nm
Transistor Count	12 billion
CUDA Cores	3,840
Texture Units	240
ROPs	96
Core/Boost Clock	1,481/1,582MHz
Memory Capacity & Type	12GB, 11.4Gb/s GDDR5X
Memory Bus	384-bit
TDP	250W
Display Connectors	DisplayPort, HDMI

TITAN X
NVIDIA

Nvidia's latest uber GPU inevitably costs megabucks.

Asus ROG Zephyrus GX501VI

A first look at Nvidia's Max-Q spec

FOR THE PAST SIX MONTHS, we've spent time with more than a dozen machines—benchmarking, playing games, and generally working—to determine the best gaming laptop. What stuck out more than anything is that gaming laptops are thinner and lighter than ever. Thanks in a large part to Nvidia's Pascal architecture (the GTX 10-series GPUs), which offers excellent performance at lower temperatures than generations past, the latest crop of gaming laptops offer superb power in a shell that's thin and light, free from huge, bulky fans.

At Computex this year, Nvidia revealed its new "Max-Q" design philosophy. In short, Max-Q is centered around finding the right balance between power and efficiency, in order to put high-performance graphics cards into the thinnest notebooks possible.

Asus's ROG Zephyrus is the first Max-Q laptop we've tested, and it delivers on that promise of thin, quiet, powerful gaming, while measuring just 20mm thick when closed. To be clear, the Zephyrus's GTX 1080 is not as powerful as its desktop equivalent—or even one found in a (much bulkier) non-Max-Q laptop. In fact, it's about 15 percent less powerful than those hefty mobile options—more on that later.

What it loses out on in raw power, the ROG Zephyrus makes up for in size and sound. The Zeph is significantly quieter than any gaming laptop we've seen. More impressively, all of these other "thin-and-lights" have mostly sported GTX 1060 (or below) GPUs, so even if the Zeph's GTX 1080 is underpowered compared to a desktop GTX 1080, it's still vastly more powerful than everything else called "thin and light."

THAT'S COOL!

To keep temperatures cool (and stay quiet in the process), the Zephyrus has a somewhat awkward keyboard layout that gives way to a rather ingenious cooling solution. The keyboard is located right at the front of the chassis—where the touchpad and wrist rests are normally situated—with the touchpad smushed over to the right. This leaves the top half of the chassis—where the keyboard would normally sit—free for a meshed ventilation area. A number of fans sit here, sucking in air to cool the GPU, before spitting it out the back through a gap that opens up when the laptop is open.

The keyboard layout is a little awkward to use (the Zeph comes boxed with an external rubber wrist rest to improve things a little), but is far from unusable. More than anything, it means you'll situate the Zephyrus a few inches further back on your desk than a normal laptop, which might be an issue if you lack desk real estate. Similarly, it's even more awkward to use on your lap, though that's not something we recommend in the first place.

In addition to the Max-Q GTX 1080, the ROG Zephyrus has all the standards of a current-gen gaming laptop: Intel Core i7-7700HQ CPU, 512GB SSD, 16GB RAM. It also features a 15.6-inch anti-glare wide-view panel, with a 1080p resolution, 120Hz refresh rate, and Nvidia's G-Sync technology. Those final two bits are the most important, because aiming for a higher frame rate at 1080p is a much better use of GPU power than attempting to run games at higher resolution.

As for performance, the Zephyrus outperforms the GTX 1070 laptop in gaming tests by about 5–10 percent, but falls short of the full-size laptop or desktop GTX 1080 systems by 10–15 percent. Of course, the trade-off in performance is more than made up for by the Zephyrus's sleek frame.

Of course, all that greatness is not without drawbacks—primarily cost. The ROG Zephyrus starts at $2,699, which sounds like a lot for its level of performance (by comparison, the ROG Strix GL502VS that it barely outperforms is roughly $1,000 cheaper). But, in this case, you're paying for the convenience of a sleek, tiny frame, and the engineering required to keep everything cool and quiet. **–BO MOORE**

VERDICT
9
KICK ASS

Asus ROG Zephyrus GX501VI

+ THUNDERFURY Beautiful design; thin and light; excellent performance; quiet.

− DIRGE Awkward keyboard layout; poor battery; expensive.

$2,699, www.asus.com

BENCHMARKS

	Asus ROG Zephyrus	Asus ROG Strix GL502VS	Alienware 17	Corsair One (Desktop)
Cinebench R15 (Index)	737	739	863	**970**
TechARP's x264 (fps)	16.48	16.52	17.1	**21.75**
PCMark 8 Creative (Index)	7,113	7,015	7,293	**8,732**
CrystalDiskMark 4K Read (MB/s)	**53.89**	35.38	38.8	38.25
CrystalDiskMark 4K Write (MB/s)	147	109.3	**165.7**	128.5
Far Cry Primal 1080p (fps)	86	80	99	**108**
The Division 1080p (fps)	84	79	98	**104**
Rise of the Tomb Raider 1080p (fps)	107	103	120	**128**
3DMark: Fire Strike (Index)	13,970	13,202	16,748	**17,997**

Best scores are in bold. All systems are equipped with an Intel Core i7-7700HQ or desktop equivalent.

SPECIFICATIONS

Processor	Intel Core i7-7700HQ @ 2.8GHz
Graphics	Nvidia GeForce GTX 1080
RAM	16GB DDR4-2400
Screen	15.6-inch 1920x1080 matte 120Hz G-Sync
Storage	512GB M.2 PCIe SSD
Battery	Four-cell Li-ion
Networking	802.11ac Wi-Fi, Bluetooth
Connectivity	1x USB 3.1 Type C, 4x USB 3.0, 1x HDMI 2.0, 3.5mm headphone/mic combo jack
Dimensions	14.9 x 10.3 x 0.6 inches
Weight	4.9lb

REPUBLIC OF GAMERS

Sleek, gorgeous, and powerful.

Thin, light, and flexible is a decent starting point for any machine.

HP EliteBook x360 1030 G2

HP's versatile convertible flexes its agile form

WHEN IS A LAPTOP not a laptop? When it's a convertible. It's not a great joke, and it isn't much of a differentiator in real terms either, but it's enough for HP to take on the road. While you can achieve some cleverness thanks to the extra flexibility of the screen hinge, you'll either use it as a laptop or as a tablet (on steroids). HP claims it actually has five modes, with "presentation," "media," and "conference" rounding things out, but you'll rarely (i.e. never) use these, even in an office environment. Don't completely dismiss its overly athletic flexibility, though, because there's a lot to love in this svelte and versatile system.

Just to return to the convertible concept a second, they're pretty hard to sell, so we'll forgive HP its hyperbole of the EliteBook's five modes. Essentially, though: Take a standard laptop, pop a fully rotatable hinge on it, and a touchscreen display, add a smattering of screen-orienting tech, and you end up with a machine that can work in multiple ways. They're quite fun to use, especially when they're as light as this, and as pleasing to hold. You can do far more than with a normal tablet, with the option of using it in more ways than a typical laptop.

There's another cunning inclusion here, that really brought the machine into its own: The HP Active Pen may set you back another $60, but we see it as a necessity for anyone looking to make the most of the machine. There's nothing to stop you using your finger, but when it comes to taking notes and drawing annotations, the pen makes for a much more natural choice. Flipping the screen all the way around and turning the machine into a tablet genuinely makes sense when you reach for the pen. The fact it can be clipped to the side of the machine for easy access makes it a trouble-free accessory to keep with you.

ALL WORK AND NO PLAY

While we have been won over by the form factor, the same can't quite be said for the internal component selection. We are unashamed performance junkies here on *Maximum PC*, so anything less than a real Core i7 has us wary (especially at this price). The fact that this uses a "Core i5-7300U"—which, it turns out, is more like a Core i3 (as in it has only two cores and four threads)—means it has a tough job of winning us over. We were momentarily hopeful about the M.2 SSD, but our benchmarks proved that this wasn't anything to get too excited about either. Raw performance isn't its forte. This is unashamedly a work machine, so you'll search in vain for anything approaching decent gaming performance (we're not going to mark down a work machine for this, though).

There are a couple of counters that explain this component selection. First, the svelteness of the machine certainly helps win us back on side—it's a shade under 15mm and weighs under 3lb. The low-power nature of the components means it doesn't get too hot either, so even at full load, it doesn't need excessive cooling. You can tell when it's working that little bit harder, but it never makes a nuisance of itself due to overzealous fans. It's worth noting that you have a couple of USB Type-A slots to plug things into, too, which means you don't have to carry around a startling array of convertors.

Where the EliteBook x360 really excels, though, is in the stamina stakes. It will quite happily stick with you through a whole day of work, and it'll still be going strong long into the evening. We clocked in at around 13 hours playing back HD movies. Not bad going by anyone's standard. This, coupled with the thin and light nature of the machine, makes for a great travel companion, even if it doesn't quite scream the kind of raw power that we're used to seeing here on *Maximum PC*. **–ALAN DEXTER**

VERDICT

8

HP EliteBook x360 1030 G2

➕ **DANGEROUS** Awesome battery life; genuinely thin and light; quality screen; good connection options.

➖ **HARMLESS** Weak CPU; uninspiring SSD performance; pricey.

$1,679, www.hp.com

BENCHMARKS

	ZERO-POINT	
TechARP x264 (fps)	6.3	7.4 (17%)
Cinebench R15 (Index)	306	350 (14%)
CrystalDiskMark 4K Read (MB/s)	43	27.9 (-35%)
CrystalDiskMark 4K Write (MB/s)	151	109.3 (-27%)
Battery Life (Mins)	226	761 (236%)
Rise of the Tomb Raider (fps)	2.6	2.2 (-15%)
3DMark Fire Strike (Index)	3,547	902 (-75%)

0% 10% 20% 30% 40% 50% 60% 70% 80% 90% 100%

Our laptop zero-point is the Asus G752VT-DH72, with an Intel Core i7-6700HQ, 3GB GTX 970M, and 16GB of DDR4-2133. All games were tested at 1080p at the highest graphical profile, with antialiasing enabled.

SPECIFICATIONS

Processor	Intel Core i5-7300U
Graphics	Intel HD Graphics 620
RAM	8GB DDR4-2133
Resolution	1920x1080
Display	13.3-inch UWVA touch
Storage	256GB M.2 TLC Opal2 SED SATA3
Connectivity	2x USB 3.1, 1x USB Type-C, 1x HDMI 1.4, 1x microSD
Dimensions	12.48 x 8.6 x 0.59 inches
Weight	2lb 14oz
Warranty	One-year parts and labor

LG 34UC79G

Do fewer pixels mean more gaming fun?

CHOOSE BETWEEN PIXELS and performance. That's the new LG 34UC79G's core proposition. More specifically, at 34 inches and with a 21:9 aspect ratio, you might expect LG's gaming panel to pack 3440x1440 pixels. Instead, it rocks a mere 2560x1080, a resolution we're more used to seeing on 29-inch superwide monitors.

The performance implications of that lower resolution are twofold. For starters, it allows the 34UC79G to crank out a 144Hz refresh rate over a standard DisplayPort 1.2 connection—3440x1440 at 144Hz requires too much bandwidth. Then there's the minor matter of GPU performance. The more pixels you have to pump, the more load you put on the GPU. In simple terms, 3440x1440 is getting on for double the number of pixels of 2560x1080. Fewer pixels mean less load and more frames.

There are, of course, downsides. That's obvious the moment you fire up the LG. Immediately, the coarseness of the pixel pitch is apparent. As a corollary, you don't get a lot of desktop real estate, either, despite the generous 34-inch proportions. The 1,080 vertical pixels feel especially stingy, and result in a lot of scrolling around web pages and other documents. Put simply, at this price, there are far better options for pure productivity.

It's not the most stellar monitor when it comes to image quality, either. Yes, it's an IPS panel. But it won't blow you away with its punch and vibrancy. The backlight lacks zing, and the standard calibration crushes some details in darker tones. A little dither-related pixel fizz is also visible in gradients.

As for pixel response, it's good enough for the gaming remit and to cash in on that 144Hz refresh rate, but it's not going to scare the best TN panels. The gentle curve is also a little perplexing. If you buy into the idea of a curved monitor, you'll be disappointed. If you don't, well, you won't want any curve at all. That said, the IPS tech does deliver fantastic vertical viewing angles and a nice color balance overall.

If all that sounds like we're down on the 34UC79G, there's no doubting it delivers in game. If you have a powerful GPU, the 34-inch widescreen panel zipping along at 100-plus frames per second is a sight to behold. In terms of response and fluidity, there is no beating a high-refresh panel. On a related note, if you have an AMD graphics card, LG includes support for the FreeSync adaptive refresh technology. There's equally no doubting that adding pixels would somewhat undermine that sense of slick, lag-free performance.

Elsewhere, you get a pretty good looking display in terms of the design of the stand and chassis. The 34UC79G sports LG's latest design language, with very thin bezels on three sides, plus a small chin along the bottom. As this is a gaming panel, it eschews the white-and-silver aesthetic of a number of new LG monitors for black and red. Whatever the look of the thing, it's very nicely put together and assembles neatly, thanks to a stand that clips efficiently into the rear of the screen enclosure.

The 34UC79G's on-screen control menu will likewise be familiar to LG fans. There are lots of options, though accessing them through the single joystick-style button on the base of the lower bezel can be tricky.

All of which makes LG's latest a niche proposition. As a productivity tool, it's limited by the relatively modest 2560x1080 native resolution. That has an impact on the crispness of the image quality, too. However, for gaming, the 34UC79G has to be worth a look. It's well priced for such a large IPS screen, and the 144Hz refresh and FreeSync support make for a fantastic gaming experience. **–JEREMY LAIRD**

VERDICT
8

LG 34UC79G

⊞ **NEED FOR SPEED** 144Hz makes for slick, responsive performance; IPS has nice colors and viewing angles.

⊟ **WALLEYE** Relatively low res; limited desktop space; not terribly crisp visuals.

$682, www.lg.com

SCREEN SPECIFICATIONS

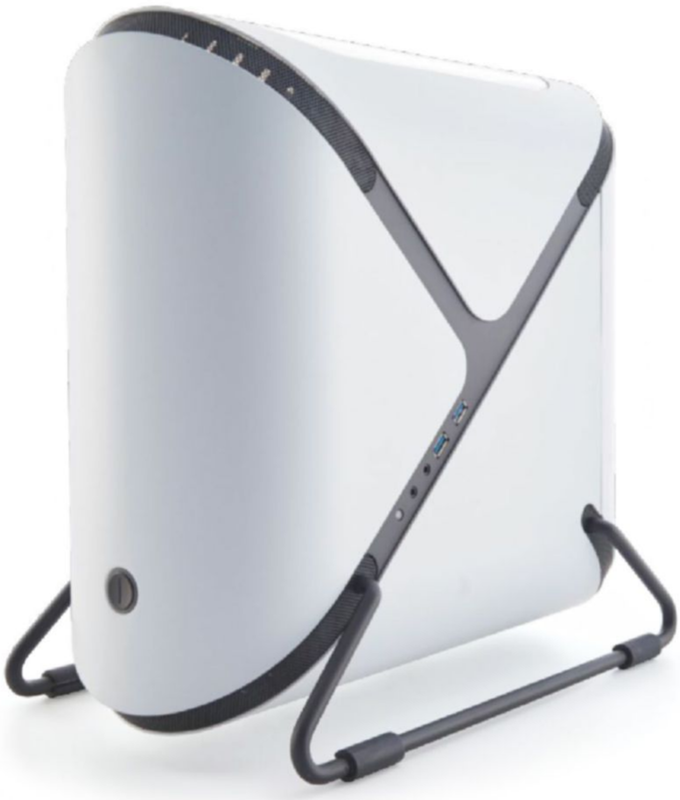
Panel Size	34 inches
Native Resolution	2560x1080
Panel Type	IPS
Max Refresh	144Hz
Pixel Density	81.72 dpi
Response	5ms
Display Input	HDMI, DisplayPort
Connectivity	USB 3.0 hub
VESA Mount	100 x 100mm
Warranty	One year

LG's latest aims for speed and response, rather than razor-sharp visuals.

techradar.
72
The home of technology
techradar.com

BitFenix Portal

Sleek ITX case inspired by a Valve puzzler, but is this a triumph?



THE REASONS to go ITX for your next build are manyfold: You reclaim valuable space; you need fewer cans of compressed air to clean it; and now, thanks to BitFenix's latest model, you can pretend you built a rig inside one of *Portal's* sentry turrets.

Perhaps the reason ITX isn't the dominant form factor is that you need to make compromises in the name of compactness, although they aren't as significant today as they once were. In the Portal's case, you need a smaller SFX power supply to power your diminutive machine, and you're limited to a single GPU that takes up a maximum of two slots. Neither is a big surprise for an ITX case, but we also recommend going as modular as possible with that PSU to minimize unnecessary cables, as this case's unusual interior design doesn't leave much room between PSU and drive bays.

There are benefits to that design, though. Rather than giving you access to the components via a removable side panel, BitFenix instead opts for a frame within a frame, so your entire build lives in an interior chassis that's accessible via a ball-bearing runner. It's also oriented so that your graphics card lies "upside down" at the very top of the case, visible through a perspex window on the top panel, although variants without the window are also available. In practice, this allows easy access to some usually hard-to-reach parts, and makes cleaning the PC much easier—just pull it out, bust out that air can, and push it back in. It does mean it's a bit more tricky for cable management, though. Certain cables can be tied in place on the interior frame, but those connected to the case itself—case fans, power button, and so on—must have enough slack to allow the interior frame to run out past the exterior. It's a little like building a ship in a bottle in that way.

With a system built inside, the exterior features of the Portal are kept minimal to stay in line with that Valve-inspired aesthetic. A single power button graces the front panel, and along one side are two USB 3.0 ports next to inputs for headphones and a mic. At the rear, an additional bracket is fitted over the GPU screw holes on the case to allow easier access to the thumbscrews, and two large gaps at the top and bottom provide exit points for the hot air as it's pushed through from front to back, helped along by a single 120mm fan at the front and an 80mm fan at the rear. There is room for a 120mm radiator to be fitted instead of that 80mm fan if you opt for a more heavy-duty CPU cooling solution, though. Below the interior frame there's also plenty of room at the base for hot air from your PSU to disperse. For a case this size, which appears so solid and unventilated at first glance, airflow actually looks ample in the Portal.

But let's be honest, if this case piques your interest, it's probably due, in large part, to its looks. In person, as it were, those looks hold up well. The aluminum panels are well finished and feel sturdy enough that transporting a built-up machine shouldn't do any damage, and it's nicely topped off with a black or white powder coat, depending on your taste. The only question mark comes in that runner design, which is fine for the initial build, but doesn't feel smooth or robust enough to endure repeated action in the long term, for frequent cleaning or regular upgrades, without exhibiting a bit of wear and tear. So, was this indeed a triumph? Unfortunately, the Portal falls just shy, but its looks and interesting design read big in the plus column. –PHIL IWANIUK

VERDICT
8

BitFenix Portal

+ **HUGE SUCCESS** Sentry turret looks; breezy airflow; frame design.

− **WHEATLEY** Flimsy runner.

$140, www.bitfenix.com

SPECIFICATIONS

Form Factor	ITX
Motherboard Support	Mini-ITX
Available Colors	Black, white (with or without window)
3.5-Inch Support	2
2.5-Inch Support	3
Radiator Support	1x 120mm
Fan Support	1x 80mm (included), 1x 120mm (included)
Dimensions	9.7 x 15.6 x 16.2 inches
Graphics Card Clearance	11.8 inches
CPU Tower Clearance	4.9 inches
Weight	12lb, 13oz

HyperX Pulsefire FPS

A mid-price, mid-range, middle of the road mouse

WE HAVE SPAT so much bile about the trend for adulterating mundane hardware with extra buttons, switches, lights, and other pointless frippery in these pages that you might presume there's a *Maximum PC*-wide stance on such things. There is not. The team is torn. Some love a pretty thing; others would rather functionality took precedence. The Pulsefire FPS seems determined to either further divide or finally unite our two camps—HyperX's scientists must have toiled hard in the hardware labs to find a formula for the most middle-ground mouse possible.

First of all, purists rejoice: It's visually subtle, neither overdoing the pizzazz nor shaped like an art project that's been left too close to a space heater. Yet even the grumpiest among us must admit there's a certain sexy charm to this thing. Glowing red LEDs—just glowing, not flashing, or pulsating, or doing anything other than being red—highlight the palm end and mouse wheel, with a single RGB LED switching color, used for a practical reason, but granted some beautiful shades, to show what resolution it's running at. The top shell is one smooth-textured piece of plastic, perfectly shaped for mousing with the heel of your hand on the desk, the stiffness of the plastic adding slight additional resistance to the switches.

On either side, there's a textured rubberized pad for additional grip; again, practical, and only lightly patterned for what seems like maximum efficiency, but definitely not unpleasant to look at. At the peak of the left edge sit two additional buttons, high enough that they don't interfere with the average resting thumb position, but in no way uncomfortable to reach. The wheel is rubberized, lightly ratcheted, and impossible to accidentally click with a heavy resting finger; beneath the mouse there are two extra large glide pads for a smooth but not slippery feel. There's a red-flecked braided cable, a quality touch that it's very hard for anyone to start turning purple about.

INSIDE INFORMATION

Inside, things are similarly considered—not unique or flashy, but well-chosen, quality components that anyone can appreciate. The main microswitches, for example, are Omron's well-regarded white-top variety, which feel solid and plenty clicky. The sensor beneath has similar mass appeal—it's a PixArt 3310, as seen in countless other mice in this particular market sector, and which was at one point in time considered the best sensor on the market. It can't keep up with the 12,000 dpi pace of many enthusiast sensors, though those are apparently made for delicate souls who game gently within a half-inch square. For normal mousers, the 3310's maximum dpi of 3,200 is plenty, and it's generally accurate and glitch-free, as long as you're using a good surface; it's not over-friendly with reflections or plain textures.

Balance and usability for high-paced FPS games might have been in the front of HyperX's minds when designing the Pulsefire FPS—there's a pretty big clue in the name—but there's no reason a gaming mouse like this can't similarly appeal to desktop warriors. Indeed, the $49 price point means this is accessible to just about everyone. That price does explain a few of its weaker spots—the unit can feel rather light (though not flimsy) at only 3.3oz; its curvy shape won't appeal to claw-grip aficionados; and there's an odd division between the feel of the forward and rear side buttons. It also can't be calibrated to your surface, unlike some competitors.

The arguments in the office are over, though. We can all, caffeine-fueled adrenaline junkies and buttoned-down pencil-pushers alike, appreciate just how solid the Pulsefire FPS is for its price. Granted, none of us actually wants to own it—we would each spend our 50 bucks on a mouse more aligned to our particular tastes—but that's a different argument altogether. **–ALEX COX**

VERDICT 8

HyperX Pulsefire FPS

+ PULSE Smooth sensor; comfortable; unifying design.

− REPULSE Lightweight; odd feel to side buttons; right-hand palm grip only.

$49, www.hyperxgaming.com

SPECIFICATIONS

Sensor	Optical
Sensitivity	3,200 dpi max
Sensor Model	PixArt 3310
Polling Rate	1,000Hz
Programmable Buttons	2
LEDs	Red, RGB mode selector
Cable Length	6 feet
Weight	3.3oz

Logitech G433

Good audio performance, but compromises made to hit its price point

YOU'LL EITHER LOVE the mesh design of Logitech's new surround sound cans, or you won't. They're certainly a striking pair of closed-cup headphones in any of the four available colors. Our test sample came in "triple black," and while it's true that Logitech's sports mesh design does help to keep the weight down to just 9.14oz, we didn't notice that they were especially breathable. More noticeable is the G433's tendency to collect and display dust in all those hard-to-reach dimples. Also included are a color-matched carry case and an alternative set of ear pads with a tighter weave, but they, too, have an unorthodox finish. Think faux chamois. They're slightly more comfortable against the ears, and a bit easier to keep clean.

But this isn't *Good Housekeeping* magazine, and headphones are there to push sound into your ears. The G433s are better at that. Built with 40mm drivers just like their forefathers, the much bulkier G430s, these lightweight cans are capable of powerful bass, and that's important. But more than that, they deliver said bass along a relatively flat frequency response, which means it doesn't sound distorted at high volumes, or muddy up the overall sound. There's a real alchemy to this, and it's as much about construction materials as it is about drivers—so maybe we're being harsh on that sports mesh after all. The upshot is that you don't need to tweak any EQ settings manually or cycle presets for different activities—gaming, music, and so on—in order to get a rich sound. It's not quite up there with Kingston's now legendary HyperX Cloud, or Sennheiser's higher-end models, but for $87, the sound can't be faulted. Surround sound, provided digitally via DTX Headphone-X, provides a really wide and yet precise soundscape, which benefits both games and movies. Digital surround can be something of a lottery, but it works well here.

As we're seeing across the headset market at the moment, focus on this model, too, has shifted away from gaming alone and broadens out into a headset that Logitech hopes you will use for all your consoles and mobile devices, too. That much is evident by the total absence of RGB lighting and tribal motifs, but it's more tangible in the additional cables that you'll find bundled in the box. While the DTX Headphone-X digital 7.1 surround is only compatible with PCs, the additional 4.9-feet cable enables you to hook this up to a PS4, Xbox One, or smartphone as a stereo headset. As for connecting to your PC, both USB and 3.5mm options are lavished upon you.

So far, so good, then. There's inevitably a "but" coming, though: There's a couple of areas in which the G433's concessions to a lower price point end up impacting upon the usability to a noticeable degree. Firstly, the microphone. We have no qualms about its sound quality or noise gate, but it's difficult to get along with that non-retractable piece of bendy rubber it's attached to. It feels like a relic from an already bygone era of gaming headsets, such is the pace of advancement and the widespread adoption of retractable or swing-arm designs that don't intrude on your peripheral vision. Our only other gripe is with the inline remote, which is small and lightweight, as per the design brief, but actually quite awkward to use. The mic mute button is very stiff and requires concerted effort to operate, and finding the tiny volume scroll wheel takes some practice.

All that nitpicking still leaves two good reasons to buy this G433 headset (two-and-a-half if you're into the mesh look): good value and solid sound. They're good boxes to check. If we were building a headset, we'd make sure it sounded good before adding luxury to the inline remote, too. There are no real deal-breakers in this package, but you should know not to expect luxury from the mic or controls before making the purchase. **–PHIL IWANIUK**

VERDICT

8

Logitech G433

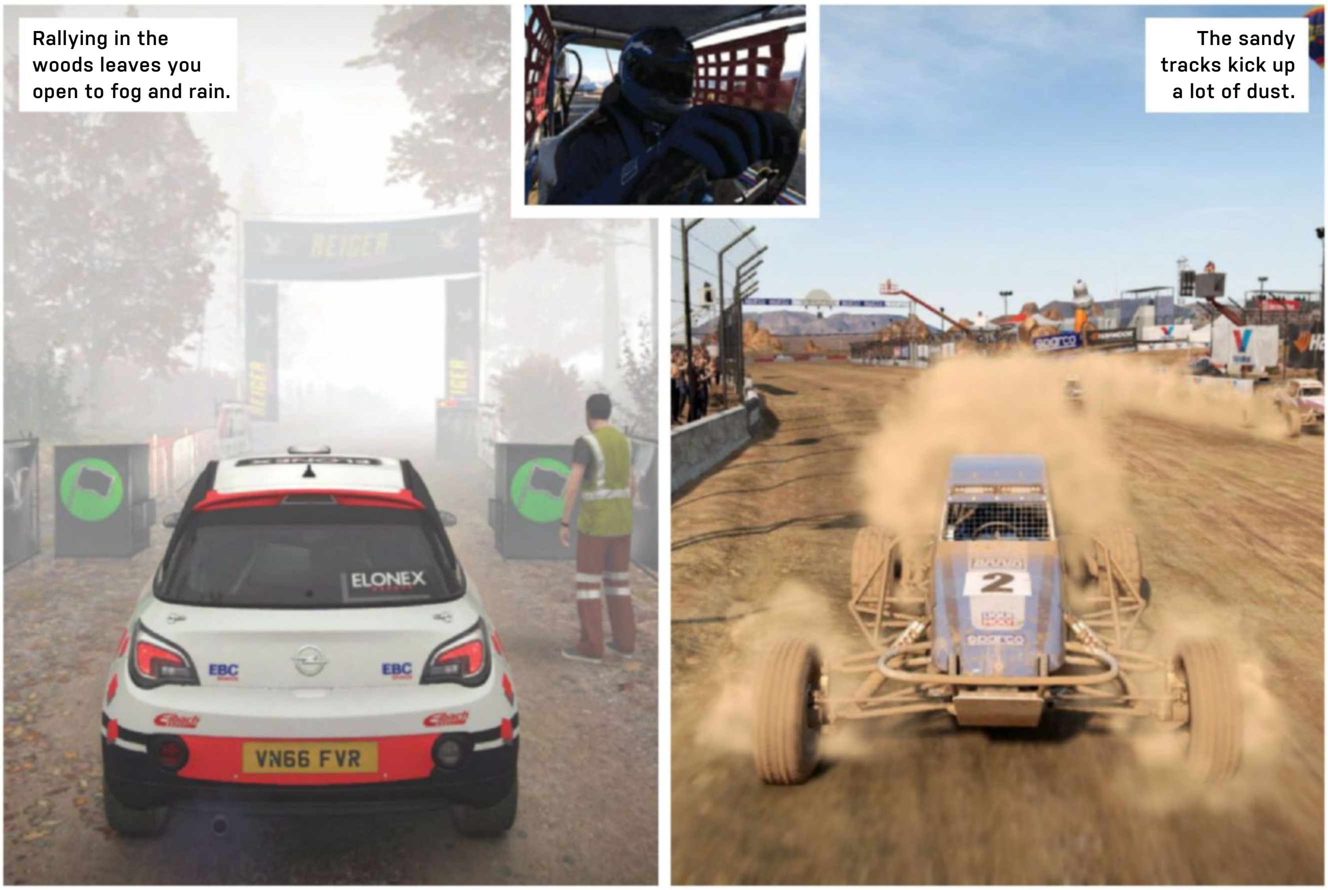
➕ **MESHMERIZING** Flat sound; strong surround; value.

➖ **HOT MESH** Basic controls.

$87, www.logitech.com

SPECIFICATIONS

Driver Type	40mm
Frequency Response	20Hz–20kHz
Design Style	Closed-cup circumaural
Microphone Type	Back-electret condenser
Connectivity	USB, 3.5mm
Weight	9.13oz
Cord Length	6.5 feet



Rallying in the woods leaves you open to fog and rain.

The sandy tracks kick up a lot of dust.

Dirt 4

Pedal to the metal—if you didn't leave it in a tree

THUNDERING ROUND the Michigan woods in a tuned hatchback may not be what you're expecting 10 seconds into a new driving game, but that's where *Dirt 4* starts. No tedious training, just you and a Ford against the gravel. It should be simple, but we find ourselves in the trees more than we'd like.

Before that, *Dirt 4* exists in a state of quantum uncertainty: Game or Simulation? Pick one, and you enter one of two parallel universes, in which the rules are subtly different to one another. Game mode is more entertaining, faster, an enjoyable blast round a track in a ridiculous vehicle. Simulation is much deeper, the tuning of your cars becomes vastly more important, and the whole game slows down as a result.

In fact, you could call this two games. Game mode is a sequel to 2011's *Dirt 3*, while Simulation follows 2015's more hardcore *Dirt Rally*. The latter was better received, thanks to its racing purity, realism, and lack of reliance on the Gymkhana obstacle course mode. It seems what players want from a rally game is a technical challenge, not a whooping idiot smashing his car up. So, Gymkhana is gone. Its replacements are more thoughtful—the Landrush buggy and truck racing, around sandy circuits, is the first you'll encounter, and makes a fine contrast to the woodland stages before it. The laps are short and the circuits not too twisty, otherwise all the racers would be sliding all over the place. Win that, and you do it all over again, this time in a pickup.

The game is clever enough to keep the modes coming. A championship is over before you've had time to tire of it, and the next provides a different vehicle and surface to race on. Practice laps are available, but restarts are unlimited in Game mode, so you can treat every run as a practice. It's this that exposes one of the downfalls of Game mode: It's a bit easy. The co-driver may be reading pace notes during rally stages, and there's a team radio to alert you to other cars and your performance in Landrush, but it's too easy to zone these things out, and see nothing but the next corner and the red marker in the top-right that denotes your placing. Having won seven races in a row, an unexpected burst of speed from a Landrush driver surprised us, but shunting him into the sidewall sorted that out. If Game mode is like this, where would Simulation take us?

Into the ditch, that's where. Suddenly, tuning mattered, damage was mounting up, and the grip at the front of our car was gone. Those pace notes began to matter, and limited restarts meant we had to concentrate. Simulation mode needs to be approached in a very different way to Game mode, and it's to the devs' credit that they've incorporated two very different approaches into one package. **–IAN EVENDEN**

VERDICT
8

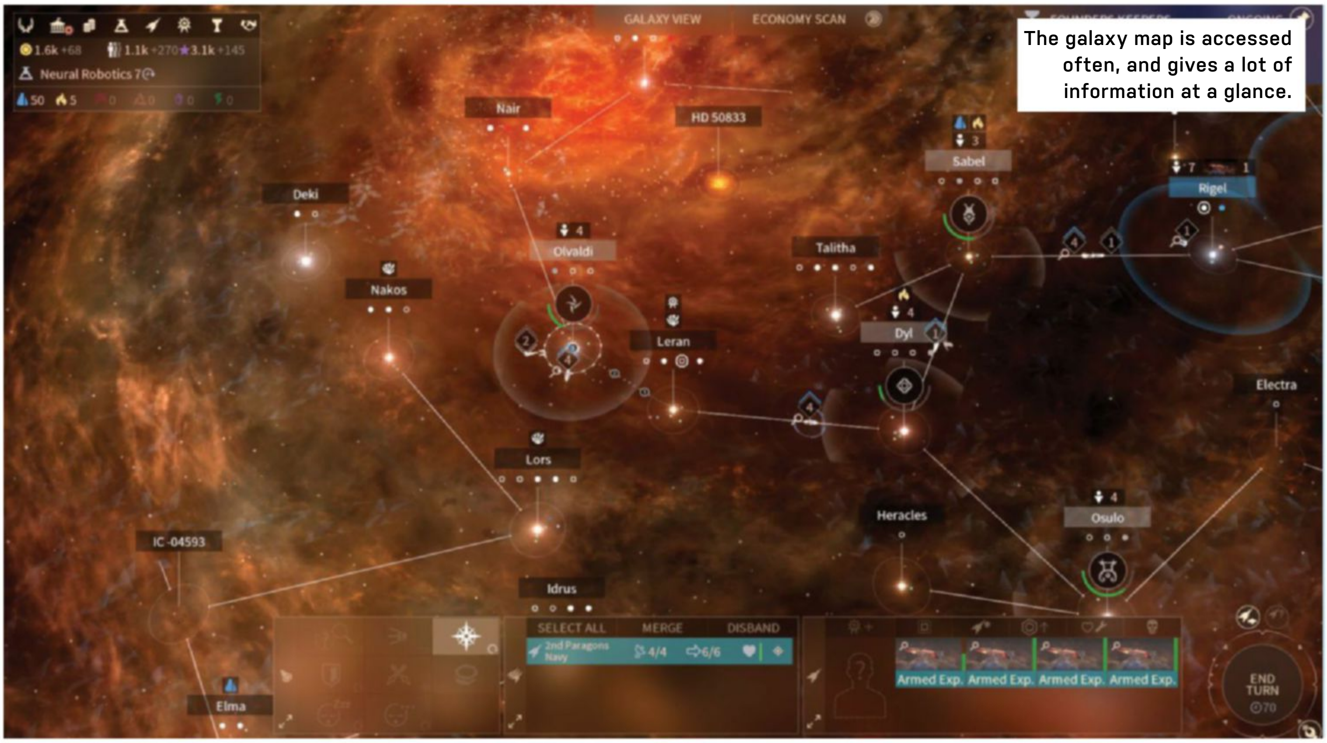
Dirt 4

+ RALLYING Fast-paced; huge depth and replay value.

− DALLYING We've seen better-looking car games; Simulation mode can be a shock.

RECOMMENDED SPECS Intel Core i5 4690 or AMD FX 8320; 8GB RAM; Nvidia GTX 780 or AMD R9 390.

$60, www.dirt4game.com, ESRB: T



The galaxy map is accessed often, and gives a lot of information at a glance.

Endless Space 2

Putting politicians in orbit never looked more inviting

THE TREE LOVES US, we're fairly certain. Its messages about trade agreements and our role in maintaining cosmic harmony certainly look affectionate. We don't think a race of sentient plants could be warlike liars, but there's a small chance they just see us as a future source of compost.

The affable arboreal astronauts are just one of *Endless Space 2's* races, along with entrail-obsessed cyborgs, perky Grays, and humans. We're deep in 4X territory here, pushing the boundaries of the genre set up by *Civilization,* and discovering light years of room for expansion beyond them.

Pushing your boundaries is what the game's all about, be they the literal borders of your empire, or the scientific limits that will allow you to explore new areas of the map, exploit resources, and crush your opponents. It also pushes at the boundaries of 4X game design a little, by being only a bit opaque and unfriendly to newcomers.

Before the game gets its teeth into you, with its mix of turn-based empire building and interplanetary politics, the interface exerts its charm. Rather than oppressing new players with reams of stats, tiny icons, and scattered notifications, it takes a somewhat Microsoftian (eighth dynasty) approach, with screen-filling notifications—this time using some nice art, too. Another step toward friendliness is to make everything optional—you can turn off the tutorials, not be bothered by many notifications, and even opt out of the 3D space battles (we recommend this, as while the ship designs are interesting, watching the sides line up and take turns firing at each other soon begins to drag).

All of this is nice, but isn't the heart of the game, which is found on the galaxy map and diplomacy screens. You have an entire galaxy to play with, but there are other civilizations waiting to get in the way, shoot holes in you, and generally ruin your plans. If you want to conquer known space, you need to negotiate your way past them, or leave them as a rapidly expanding and cooling cloud of plasma. Either works, but if you try the latter, you may come unstuck, unless you're really, really sure.

The other races are a mixed bunch: some aggressive, others passive; some liars, others genuinely going to blow you out of space, and enslave your colonists. They all play by different rules, their colonization options dependent on things as diverse as colony ships or interstellar space roots, and once you're out of the starting human empire faction, the differences open up. You'll soon (well, after a few tens of hours) settle on a favored faction for multiplayer.

Performance is generally very good, never leaving 60fps on last-gen hardware, and the enormous number of CPU calculations spread throughout the turn, so there's no hiatus at the end. The map remains accessible throughout, so even when cunning plans are being hatched against you, you can admire your warships.

Endless Space 2 is a streamlining of the sci-fi 4X, which needed to be done. All the options are there (you need to design your own spaceships, but there's an auto-design button), but can be easily cleared out of the way, so you can concentrate on the conquest of the galaxy. The interface makes it easy to get to grips with, but the game design includes all the depth, political intrigue, diplomacy, and violence you could need. It's a triumph from French studio Amplitude, a game that provides a good starting point for those new to 4X, as well as offering plenty for veterans to chew on. **–IAN EVENDEN**

VERDICT 9

Endless Space 2

+ NEBULA Great interface; deep systems; interesting lore.

– PULSAR Occasional turn-end glitches; some things still not explained clearly.

RECOMMENDED SPECS Intel Core i5-3570, AMD FX4170, or newer; 8GB RAM; AMD Radeon 8000, Nvidia GTX 660, or newer.

$40, www.endless-space.com, ESRB: E

LAB NOTES

ZAK STOREY, REVIEWS EDITOR

Blood, Sweat, and Millennial Tears

It cost more than money to build this year's Dream Machine

DREAM MACHINE 2017, you have ruined me. Five whole days of planning, stripping, drilling, installing, reworking, and rebuilding one of the biggest and most advanced systems I've ever worked on have left me mentally destroyed. It is certainly a thing of beauty, and an absolute beast of a machine, beyond anything I've ever worked on, but is it the Dream Machine for me? Ironically, probably not.

If you've been following my musings for a while now, you'll know I am wholeheartedly dedicated to the ITX and microATX form factors. Bigger isn't always better for me, and although the power toiling away within the bowels of this year's DM is incredible, there's little here that would affect my day-to-day activities in any meaningful manner, outside of the GPUs. However, if I want to migrate to a smaller rig than the ATX tower I have in my own home, the problem is two-fold: It all comes down to cases and processors. In short, for my next system, I'm craving a Ryzen eight-core CPU (preferably the Ryzen 7 1700)—problem is, there are very few motherboards on the X370 platform, in that form factor, and fewer still that operate well and look good.

Ryzen, being the relatively power-hungry monster it is, demands a substantial amount of VRMs to operate effectively. Which is something you can't easily pack into the ITX form factor without including a raised PCB, similar to what Asus used to do with its Impact series. And, secondly, outside of the Manta, there aren't any cases that look good, have solid airflow, and support the liquid-cooling I want to introduce.

For the time being, at least, it looks as though I'm stuck with my NZXT S310 Elite. At least until another ITX chassis launches that offers the same flair and support as the Manta. Or perhaps a desk PC would fit the bill better? Hmm, now that sounds like a solid idea....

It may be a Dream Machine, but this thing is just too big for my den.

BO MOORE

Technology Editor

If you've followed my last few Lab Notes, you'll know my life has been consumed by laptop testing. This month continues that trend, save for one small but significant difference: I finally got the chance to test Nvidia's new Max-Q design philosophy. As seen in my review of the Asus ROG Zephyrus (page 80), I'm excited about Nvidia's promise of compact and portable laptops that don't skimp on power.

The Zephyrus is still the only Max-Q laptop I've tested, but I'm planning time with other GTX 1080 systems soon, and it'll be interesting to see how the different OEMs (Acer, Gigabyte, MSI, and Sager all have Max-Q models) interpret Nvidia's philosophy—and how they stack up against their own kind, rather than non-Max-Q fare.

I'm also curious to see how the slightly lower spec Max-Q laptops hold up. Considering that the Zephyrus and its Max-Q GTX 1080 performed only slightly better than a desktop-class GTX 1070, it'll be interesting to see how a Max-Q GTX 1070 compares. If it's only a small downgrade in performance, I can see Max-Q 1070 laptops becoming a favorite, offering the best balance of price, performance, and portability.

On the other hand, it'll be a harder recommendation if the Max-Q philosophy pushes the 1070 down closer to GTX 1060 performance. Either way, we'll know more soon.

Editors' Picks:
Digital Discoveries

Tuan Nguyen, editor-in-chief, and Alan Dexter, executive editor, reveal their latest tech loves

ASUSTOR AS6208T

In the world of storage, more is better. There was a time when I thought a 1GB hard drive was substantial. I also remembering paying $300 for one when they'd just come out. These days, 1GB is absolutely puny.

Enter the Asustor AS6208T. I've been testing this unit for a while, fully loaded with eight Western Digital Red 6TB NAS drives. The Asustor is a business-class network attached storage device that has everything an enthusiast or home user would want: multiple Ethernet ports, USB 3.0, eSATA, and even HDMI and SPDIF output. Equipped with an Intel 1.6GHz quad-core Celeron and 4GB of RAM, the AS6208T can even act as a standalone PC. That's not to say you should use it as one, but if you're looking for a beefy home-theater machine, a NAS such as this might just be worth it.

Asustor has NASes that support 10-gigabit speeds, but the AS6208T tops out at 1Gb Ethernet. For most users, this is enough, especially if the unit is serving up movies to your home theater machine directly.

Performance has been good so far, and I haven't ever experienced slowdowns. The only nitpick is Asustor's ADM software. It's horrible, and Asustor could learn a thing or two from Synology or QNAP.

$1,100, www.asustor.com

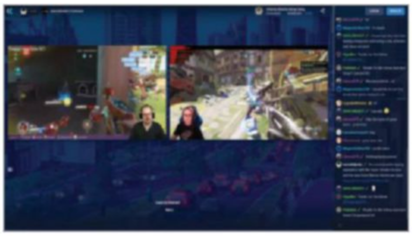
MIXER

Not long after introducing direct streaming to Beam in Windows 10, Microsoft changed the service's name to Mixer. It now supports co-streaming, and has better cell phone support. The service is trundling along smoothly enough, but it still has the same problem that it did when we first saw it—there just aren't enough people using it.

In case you didn't know, the big two streaming services are YouTube and Twitch, and it's the latter that rules the roost for day-to-day streaming. This is where you'll find gaming celebrities plying their trade, and where you can easily watch gamers playing games. If you're struggling to understand why you'd want to watch someone else play a game, the parallels to sports are obvious, and there are plenty of streamers who are just downright entertaining, making the whole thing feel like a whacky radio station.

Twitch isn't without foibles (the chat that accompanies a stream can be frustrating, to say the least), and with more viewers, the chance of interacting with the streamer becomes harder. So, in theory, Mixer could be the place to be, but with fewer watchers, you have fewer streamers, then it feels you don't have the choice that you do on Twitch. It's tough to make it in the tech world.

Free, www.mixer.com



GEEK TESTED & APPROVED

Amazon Fire 7 Tablet

I'VE BOUGHT SEVERAL Amazon tablets over the years, but they've generally been gifts for others. This changed recently when I grabbed a budget Fire 7 for myself in the Amazon Prime Day sale. When a tablet sets you back just $30, it seems ridiculous not to have one to mess around with. Thirty bucks! Crazy. Even before being reduced, though, it's still decent technology for just $50.

I had actually been planning on getting one for a while, as I've been intending to put CyanogenMod on my wife's Fire 7, but didn't want to risk leaving her without a working tablet (there's always a chance of "bricking" any tablet with such a process). So, the plan was to grab a second Fire, try it out on there, then I could safely repeat the process on hers, so that she'll have the full gamut of Android apps to play around with.

That was the theory.

In reality, I still haven't "upgraded" the tablet, because… Well, to be honest, it's actually pretty good as it is. I've been using it to catch up on a bit of reading (so many friends have written books that I've got an impressive backlog to work through), and the apps that are available are much better than when I last looked. In fact, everything I can think of seems to be covered, even if it's indirectly. It would seem that pushing out so many cheap tablets has made it a viable platform for developers, and while there may be some app that ultimately forces my hand, right now I'm just enjoying the crazy bargain as it was meant to be. **–AD**

$50, www.amazon.com

LETTERS

WE TACKLE TOUGH READER QUESTIONS ON...

> Ryzen vs. Intel
> Home Networking
> Creators Update

Comparing Cars

I know this is *Maximum PC,* but why use a Core i7-6950x processor costing $1,600 when an i7-7700k at $300 would be a much fairer comparison with Ryzen in both performance and cost. I'm a long-time subscriber, but this build-off makes Ryzen seem like it is the affordable performance option, when it is not. The i7-7700k is as fast at stock, and can comfortably overclock to 5GHz. Most comparison sites have the i7-7700k 9 percent faster than Ryzen, so it doesn't seem like there's a reason to compare a Ferrari with a Mustang, when a Camaro would be fairer. I think a rematch is in order: Ryzen versus Intel i7-7700k, and let the readers decide which makes more cents (pun intended). **–OB**

EXECUTIVE EDITOR ALAN DEXTER RESPONDS: We actually did compare both of our workstation systems to the Core i7-7700k—that's what we used as the zero-point in the tests. And while the results varied for both machines, you'll see, for instance, that Ryzen was 41 percent faster in the X264 benchmark, and 4 percent faster in the Gigapan test, although slower at the Premier Pro benchmark (by 9 percent). Ultimately, though, we were comparing high-end workstation-class hardware, and while we're big fans of the Core i7-7700K for most normal tasks, when you get to heavy number-crunching, it isn't quite the performance king that some sites would have you believe.

Signaling Thanks

Just wanted to thank you for the very timely article, "Networking 101" (July 2017). I'm not only amid my personal CompTIA N+ Exam studies, but also would enjoy seeing more network coverage, and up-to-date information on these magical boxes we call home. The Internet does require more know-how than just making the connections from time to time. It's handy to have this kind of knowledge, and after reading, I'm looking into Wi-Fi mesh for my home nightmare of weak signals. **–Ryan Anthony**

EXECUTIVE EDITOR ALAN DEXTER RESPONDS: Glad to hear you enjoyed it, and good luck with the studies.

Going Back in Time

I have little use for the features in the Creator's Update. The emphasis is on gaming, but I have never played a computer game in my life, other than Solitaire.

3D Paint? I use Adobe Illustrator, and have no interest in 3D printing. Improvements to Edge? I use Firefox and Thunderbird. Better streaming? My only internet option is Verizon Wireless, so forget it, even if I wanted to (ditto for broadcasting with Beam). And why watch a movie on a 24-inch monitor when I can do so on a 63-inch HD screen? Night Light sounds useful, but getting it is not worth having my desktop littered with tiles that won't let me remove them.

My computer is a work tool. My system and desktop are set up the way I like it, and I don't need Microsoft messing around with it. How can I get just the security updates, driver fixes, and so on—in short, everything except what messes with my personalized desktop and configuration?

I have seriously considered going back to Win 7, and may do so if this continues. **–Rick Thompson**

EXECUTIVE EDITOR ALAN DEXTER RESPONDS: While I feel your pain (not so much with Win 10, but definitely with Win 8), there's something to be said for sticking with the latest version of Windows, and that pretty much starts and ends with protection. Sure, you may not need all the extra "features" that come with a new release or update of Windows, but you do want Microsoft on your side, fighting exploits and patching code to make sure you're protected.

Having said that, rolling back to Windows 7 wouldn't be the worst thing in the world, especially if you bear in mind that at some point support will stop, and you'll either have to upgrade, or come up with another solution. You wouldn't be on your own—the recent Steam Survey had a third of users still running the beloved Win 7 (while Windows 10 had the lion's share, at just over 50 percent).

Value Proposition

The builds at the back of the magazine appear to double in price as you go from budget to mid-range to turbo ($600, $1400, $2900). So,

↘ submit your questions to: comments@maximumpc.com does performance increase linearly, too? Which is the best value? Is it really better to spend more?

I think it is, if we choose the right mix of components. For example, gaming is far less important to me than serious 2D and 3D programs, so I need more CPU cores than a very expensive GPU. We all need RAM and SSD. Maybe that is why "roll your own" is the best answer.

What are your thoughts? Which items yield more bang for more bucks? Which are better to pay less for?

–Doug Schafer

EXECUTIVE EDITOR ALAN DEXTER RESPONDS: We do consider value in every review (the Titan Xp on page 78 being a good example), but what you want out of a piece of hardware may be different to what someone else wants. As you point out, gaming isn't so important to you, so you're obviously going to have a different opinion to another reader.

It can be tricky as well, because as you pay more, it generally enables you to do more. An Nvidia GeForce 1080 Ti, for instance, can hit 60fps at 4K in certain games, while a 1050 may only hit 10fps at the same settings. Does that make the Ti six times better? Hardly. And some things are even harder to ascertain—how do you objectively compare a 4K IPS professional panel to a 1080p TN gaming screen?

Still, we like a challenge, and this is something we'll investigate further, as there are certain pieces of gear that jump out as being great value—the GeForce GTX 1060 instinctively feels like a great card for the money as far as 1080p gaming goes. Watch this space. Until then, rolling your own is absolutely the way we'd go.

Metaphorical Misfire

On page 14 of the July issue, Chris Lloyd talks about the US Army having Tomahawk missiles. I was in the Navy for 22 years, and my last job was Pacific Fleet Cruise Missile Officer. I can assure you that the Army never had and will never have Tomahawks. These are ship-launched only.

–Rona

NEWS EDITOR, CHRIS LLOYD RESPONDS: It wasn't actually said by me, it was Microsoft's president, Brad Smith. He was referring to the army as a generic "armed forces" at a guess. I just didn't question him.

Coaxial Cleverness

I really liked the "Set Up the Perfect Network" article in the July issue. It mentioned using powerline equipment, such as HomePlug brand, to expand the network without having to run cables behind walls and through floors. Another alternative, although not as versatile as HomePlug, is to use MoCA adapters. You do need an active coax feed in the room where you want to add wired Internet access, so if you don't have this, HomePlug is a better alternative.

I bought a house where there were active coax connections on the walls in just about every room. I was telling a friend, a professor teaching wireless networking, that my wireless "n" network was starting to get bogged down with all the devices I had. He suggested MoCA adapters. We both have Verizon FiOS, and he had been using these adapters for several years.

I ordered two Actiontec adapters from Amazon—the ones specified for homes without MoCA routers, as I did not have cable service. The adapter has a separate input and an output for a coax cable, an RJ-45 jack, and power connector. They also have indicator lights for power, coax, and Ethernet. The adapter acts as a pass-through for the TV signal, and you're instructed to run a coax cable from the output jack of the adapter connects to a TV's set-top box (STB).

My friend recommended not using the pass-through feature for the TV signal, but to run the coax coming out of the wall into a two-way coax signal splitter; running one cable from the output of the splitter to the MoCA adapter, and the other to the STB. If you run a coax cable from the output of the adapter to your STB, you lose certain features, such as the on-screen TV guide. He also recommended using at least a 1GHz splitter.

Once I had the adapters connected, I had Internet access, and was able to get a bunch of devices off the wireless network. I checked the download and upload speeds of the devices using www.speedtest.net, and they were the same as the devices connected directly to the Verizon router.

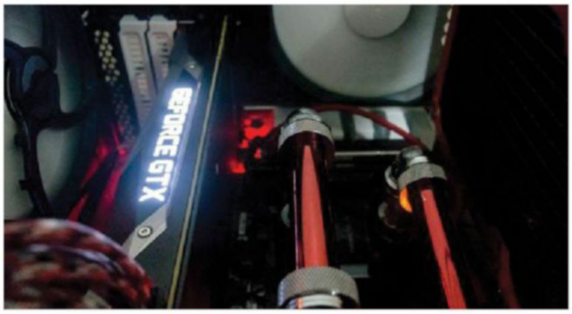
Compared to HomePlug, using MoCA adapters is a bit more work and won't meet everyone's needs. Every room in a house has AC outlets, but not active coax feeds. You need an extra coax cable, Ethernet cable, and a signal splitter if you choose to use one instead of the pass-through feature of the adapter. I had considered powerline equipment, and I know that it has improved since it first became available. However, your article mentioned one limiting factor, which would have been a problem for me: "noise" on the electrical circuit. My house is over 50 years old, and I have to use UPS/battery backups with line conditioners so my sensitive devices get good, clean power. I did not experience any loss in speed with the MoCA adapters, which I would have with powerline equipment.

–Michael Craddock

EXECUTIVE EDITOR ALAN DEXTER RESPONDS: We hadn't considered that, so thanks for the heads-up. I've printed your letter almost in full, in case it's any use for other readers.

[NOW ONLINE]

REMOVE THE GREEN TINT FROM THE GEFORCE LOGO ON YOUR GRAPHICS CARD



Oh, Nvidia, why must you be green? Are you jealous? If not, please stop ruining our color scheme. As enthusiasts, we often strive to have the perfectly matched build. The right color motherboard, cable sleeving, CPU cooler, and case accessories. Usually, we can find a GPU with the perfect cooler to match; however, sometimes reference cards are the only option available. Or, maybe you have a smaller case with minimal airflow, and require a blower-style cooler. Whatever the reason, if you choose to go with Nvidia, you are saddled with a big green logo. Unless you follow our advice....
Read the full article at http://bit.ly/2uiMEpt.

Future

MAXIMUM PC DIGITAL EDITION

ANYTIME, ANYWHERE!

AS LITTLE AS
$1.99
PER ISSUE!
MAXIMUMPC
BUILD IT!
DREAM MACHINE 2017
Hardcore hardware pushed to the limit
Intel Core i9-7900X
Twin Titan Xps
1TB M.2s in RAID 0
STREAM EVERYTHING
STEP-BY-STEP GUIDE

Delivery of **MAXIMUM PC**, in your choice of
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Search for **MAXIMUM PC**
on your device's app store to download now

Available on the App Store GET THE MAGAZINE ON Google play zinio™

THE BUILDS

BUDGET

INGREDIENTS

PART		PRICE
Case	Phanteks Enthoo Evolv ITX	$70
PSU	EVGA 450B Bronze	$35
Mobo	MSI B250I PRO Mini ITX	$90
CPU	Intel Pentium G4600	$87
GPU	EVGA GeForce GTX 1050 Ti SC Gaming 4GB **NEW**	$155
RAM	8GB (2x 4GB) Patriot Viper Elite DDR4 2400 **NEW**	$57
SSD	Kingston SSDNow UV400 120GB SATA 2.5-inch	$60
HDD	1TB Seagate BarraCuda E.2 7,200rpm	$45
OS	Ubuntu Desktop Linux 16.04 LTS 64-bit	$16

Approximate Price: $615

WITH ONE EXCEPTION, there weren't a lot of price moves for our budget build this issue. The EVGA power supply saw a $5 saving, with a further $10 rebate on offer, although we don't include those in the pricing, as such deals can be short-lived. Worth watching out for when you're buying, though. There's no change on the CPU or motherboard front, but the continuing scarcity of graphics cards, thanks to cryptocurrency mining, means that options here are limited. We've seen a $15 increase since last issue for a similar card (we've switched to EVGA as last month's Gigabyte was out of stock), but it does come with a copy of *Rocket League* (a great game). We switched to Patriot Viper memory to try to save some cash, but that was swallowed by a price increase on the SSD. Overall, we're pleased that we managed to keep a vague check on the price increase, but suggest waiting for the mining bubble to burst if you can.

MID-RANGE

INGREDIENTS

PART		PRICE
Case	NZXT S340 Elite	$100
PSU	EVGA SuperNOVA 550 G2	$90
Mobo	MSI X370 SLI PLUS	$140
CPU	AMD Ryzen 5 1400	$165
Cooler	Corsair H100i v2 + bracket	$110 + $5
GPU	Zotac GeForce GTX 1060 6GB **NEW**	$360
RAM	16GB (2x 8GB) Patriot Viper 4 DDR4-2666 **NEW**	$120
SSD	250GB Samsung 960 Evo M.2 PCIe NVMe SSD	$128
HDD	Western Digital Blue Series 1TB 7,200rpm	$50
OS	Windows 10 Home 64-bit OEM	$100

Approximate Price: $1,368

THIS IS GETTING SILLY. Two months ago, a GeForce GTX 1070 would have set you back $350, at the time of writing you're looking at $600. You can pick up a GTX 1080 for that much. However, this is a mid-range build, and as such, throwing half the budget on the graphics card doesn't make sense for everyone, so we've dropped down to using a 6GB GTX 1060 instead. Hardly ideal, but while mining is driving up the price of cards, now is not a great time to be buying. Elsewhere, the machine doesn't change much—we were tempted to move up to a Ryzen 5 1600, but we're trying to get the overall price down, so will save that shift for another day. It's worth looking at the bundle deals that will pair up your CPU with a compatible motherboard and possibly memory for a reasonable saving. Don't go for a motherboard you don't want, though—here we recommend going for an X370 motherboard, as opposed to dropping down to a B350, just to save a few bucks.

TURBO

IF YOU'VE LOOKED AT THE DETAILS of the other two machines in this month's build, it'll come as no surprise to see that we've had to change the graphics card in our turbo machine, too. The previous PNY GeForce GTX 1080 Ti FE was out of stock, snapped up by those number-crunching Ether miners, no doubt, so we had to swap out for a standard-clocked card. The effects on pricing aren't so great at the high-end, and the $10 premium over last month's card isn't ideal, but it's hasn't forced us to drop to a slower card.

As mentioned in our mid-range build, it pays to look at motherboard and CPU bundles, and at the time of going to press, Newegg has a deal on the AMD Ryzen 7 1700 and the MSI X370 Gaming Pro Carbon, saving $46 compared to buying the components separately. There's another bundle that includes memory, although only half of what we've specced this machine out with, but still worth considering if you're looking to make your money stretch further. Pick your motherboard of choice, then see what deals are available—it can throw up some tempting offers, even enabling you to get a faster CPU for nearly the same cash.

We actually saw a slight drop in the memory pricing this month—down $5 from the previous issue—which was a pleasant surprise, given the general trend for much of this year. Even more welcome, though, is the $50 saving on the Samsung M.2 NVMe SSD, which helps bring the overall cost of this machine below last month's.

For more of our component recommendations, visit www.maximumpc.com/best-of-the-best

INGREDIENTS

PART			PRICE
Case	Phanteks Eclipse P400S Tempered Glass Silent Edition		$90
PSU	Corsair RM750X Modular Gold		$100
Mobo	MSI X370 Gaming Pro Carbon		$180
CPU	AMD Ryzen 7 1700	**NEW**	$310
Cooler	NZXT Kraken X62 280mm AIO		$160
GPU	PNY GeForce GTX 1080 Ti FE	**NEW**	$710
RAM	32GB (2x 16GB) Corsair Vengeance LED DDR4 2666		$250
SSD	1TB Samsung 960 Pro M.2 NVMe SSD		$580
HDD	4TB WD Black 7,200rpm		$200
OS	Windows 10 Home 64-bit OEM		$100

Approximate Price: $2,680

UPGRADE OF THE MONTH

NVIDIA GEFORCE GTX 1080 TI

GEFORCE GTX 1080 Ti

It's a sign of the times that the cards least affected by the cryptocurrency mining fad are the most expensive. Where we've seen prices double for more affordable cards, at the high end, pricing has hardly shifted—just $10 on the 1080 Ti. This is a great GPU if you can justify its cost, and it's your best bet for handling 4K right now. Of course, when the mining market implodes, as it will, we should see the second-hand market flooded with plenty of good quality, affordable cards. Even then, this will still be a great card.

$710, www.nvidia.com

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